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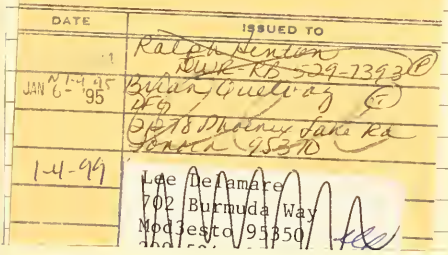


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# FORTY-THIRD BIENNIAL REPORT

CALIFORNIA
*DEPARTMENT OF*
FISH AND GAME

*FOR THE YEARS*
1952 - 1954

STATE OF CALIFORNIA
DEPARTMENT OF FISH AND GAME

FORTY-THIRD

BIENNIAL REPORT

of the

# DEPARTMENT OF FISH AND GAME

November, 1954

STATE OF CALIFORNIA

DEPARTMENT OF FISH AND GAME

GOODWIN J. KNIGHT, *Governor*

FISH AND GAME COMMISSION

William J. Silva, *Chairman*, Modesto

Lee F. Payne, Los Angeles
Harley E. Knox, San Diego
Carl F. Wente, San Francisco
Weldon L. Oxley, Redding

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DIRECTOR

STATE OF CALIFORNIA
Department of Fish and Game

926 J STREET
SACRAMENTO 14, CALIFORNIA

His Excellency, Goodwin J. Knight
*Governor of the State of California*
*Sacramento, California*

Sir:

We have the honor to submit herewith the Forty-third Biennial Report, covering the period July 1, 1952, through June 30, 1954.

This report covers the period during which the department put into effect the decentralized reorganization plan established by the Legislature on June 1, 1951, and the transfer of headquarters from San Francisco to Sacramento, to create a more efficient operating agency.

In addition the report contains accounts of activities and plans of the Wildlife Conservation Board, the Marine Research Committee, and the various branches of the department in fostering the conservation and wise uses of California's wildlife resources.

A summary of important policy decisions of the Fish and Game Commission and important new legislation affecting fish and game also is included.

Respectfully submitted,

Seth Gordon

*Director*

# REPORT OF THE DIRECTOR

*Hunting, angling license buyers continue to increase.*

*Departmental reorganization plan placed in effect.*

*Water projects added as staff function.*

*Ten-year plan presented to legislative committees.*

*Conservation education activity stepped up.*

# REPORT OF THE DIRECTOR

*"Conservation Is the Triumph of Common Sense Over Ignorance and Greed"*
—California Junior Chamber of Commerce

Believing that an informed public is the best guarantee of wise use of California's wildlife resources, and fully able to judge the effectiveness of conservation programs to that end, the department consolidated and materially strengthened its program of conservation education during the past two years in an effort to keep abreast of the ever-increasing population pressures and the record numbers of anglers and hunters afield in California.

At the same time the task of maintaining, protecting and increasing, where possible, fish and wildlife resources, consolidating gains effected by reorganization on a decentralized plan passed by the Legislature in 1951 and making long-range plans for the future, were major goals of every department employee.

Indications are that the complexity of these tasks will increase rather than decrease or reach a plateau in the years to come. During the past two years the numbers of anglers and hunters increased at a rate even faster than the tremendous population gains which show no signs of slackening.

In 1952 the number of license holders was 1,600,000. As of the close of the biennium there were 1,871,000 or a gain of one-fifth in only two years. This increased army of hunters and fishermen made their presence known with continuing requests for more fish in the streams and lakes, more game birds and mammals, and more places to hunt and fish.

As cities grew larger and more and more lands were developed for intensive agriculture and industry, resulting in material loss of wildlife habitat, need and demand grew for assured public access to hunting and fishing areas heretofore unreachable.

Other lovers of the out-of-doors who do not hunt, but enjoy and make use of California's wildlife resources in other ways are also concerned with expanded access.

### Recreational Attractions

Ironically, one of the main factors in bringing to California this tremendous migration has been this State's great and unparalleled year-long recreational attractions, including its opportunities for hunting and fishing. Thus the numbers of outdoorsmen who become new residents of California add to the pressure on wildlife in greater proportion than normally.

In spite of these conditions the Department of Fish and Game was able to show substantial progress in many wildlife management fields. Its hatchery and trout planting program, expansion of waterfowl management areas where the public can hunt, more cooperative pheasant hunting areas, big game management, stream improvement, upland game habitat improvements, and efforts to make available closed areas have made substantial contributions to the overall wildlife picture.

The darkest picture, and one of constant concern to the department, is the condition of the ocean fisheries. During the biennium the State's commercial ocean catch dropped to a 20-year low. Sardines as a commercial catch have virtually disappeared from offshore waters. Alarming danger signals are being observed in the anchovy and Pacific mackerel fishery. Warnings of this condition have been made repeatedly by department scientists. On the other hand ocean sportsfishing has increased materially in recent years, and shows signs of matching inland angling in popularity with Californians.

The responsibility of the California Department of Fish and Game in these significant times is clear. Its primary duty, in conjunction with its policy-making body, the Fish and Game Commission, is to perpetuate, manage, and, where possible to increase the wildlife resources of the State, consistent with their wise use and habitat needs.

### Appreciation for Outdoors

These responsibilities become greater and more difficult to effect, not only because of the increased numbers of hunters and fishermen, but through pressures of advancing civilization and growth. It has become a matter of integrating a sound wildlife management program with a burgeoning industrial and agricultural growth, so that the California citizen of today and tomorrow can continue to develop an appreciation for outdoor living and the character building values derived therefrom.

Encouraging signs have been developing in the philosophy of forward thinking Californians along these lines during the past two years. Planners are beginning to find a place for outdoor life and recreational possibilities in their schemes of future development. The Department of Fish and Game has and will continue to encourage this important trend of thinking.

Important as long-range planning is to our wildlife resource, the problem of meeting angling and

*This scene on the San Gabriel River on opening day of the 1954 trout season illustrates the kind of fishing pressure California's streams and lakes are getting.*

hunting pressure on a day-to-day basis reaches proportions which are hard to visualize. In two years the number of licensed hunters and fishermen has increased by 300,000. Many of them are trout fishermen who expect to fill their creels in spite of the fact that natural reproduction of wild fish has reached the point of no return in many streams and lakes. Thousands are pheasant hunters expecting success in areas where agriculture and urban expansion have cut natural habitat alarmingly. Duck hunters increase while more and more marsh land, absolutely necessary to the species, is being reclaimed and developed.

### Habitat Improvement

To keep apace with these pressures, the department has embarked on programs of habitat improvement in field and stream; game management to attain a balance between numbers of deer, existing range forage, and hunter harvest; a vast program of planting catchable trout in roadside waters where fingerling planting has reached the point of no return; constant efforts to improve streams through flow maintenance dams, clearance of obstructions, removal of trash fish and restocking with desirable species; a program of screening irrigation water diversions to keep all fish in the rivers, and ladders to preserve migratory fish such as salmon and steelhead; watering devices for quail, maintained game farms, and developed waterfowl management areas.

The problem of reducing waterfowl depredations on agricultural crops has been attacked with increasing success. Land and water development agencies now are working more closely with the department in planning for future water conservation structures and developments.

A stepped-up program of hunter safety was inaugurated during the latter part of the biennium as a result of far-sighted action by the State Legislature. This legislation required hunters under the age of 16 years, applying for a license for the first time, to show evidence of at least four hours instruction in handling firearms, and in the rudiments of hunter safety and courtesy.

Plans were completed for a department-wide training program designed to increase the operating efficiency of Fish and Game personnel and thus save thousands of dollars of license fees and other funds which can be diverted to more productive channels.

This is the picture of the past two years. It is a period of notable gains in many wildlife fields, reverses in some others. It is a period of constantly expanding hunting and fishing pressure, of lessons learned the hard way, and of lessons learned in the field of departmental research. It has been two years of new, bold steps by the commission and the department in the fields of fish and game management. Above and beyond all of these things, it has been a "shakedown cruise" for departmental reorganization, and a period for looking ahead.

### 10-year Estimate

Near the end of the biennium several legislative groups, cognizant of all of these factors, requested that the director prepare a 10-year estimate of future needs of California fish and game. The estimate was presented at a joint meeting of the Assembly Subcommittee on Public Lands, Grazing and Forest Practice, Assemblyman Lloyd W. Lowrey, Chairman; Senate Interim Committee on Public Lands, Senator Edwin J. Regan, Chairman; Assembly Committee on Agriculture, Assemblyman George A. Clarke, Chairman; Assembly Committee on Conservation, Planning, and Public Works, Assemblyman Francis Lindsay, Chairman, on June 23, 1954.

This estimate, to be discussed at length in other parts of this report, poses problems and implications directly affecting millions of Californians, whether they be hunters or fishermen, students of nature, photographers of wildlife, disciples of Audubon, skin divers, or merely lovers of the out-of-doors.

Needless to say, a fish and game department which confined its efforts to problems of the day, season, or biennium, would not be properly discharging its trusteeship to the people. The California Department of Fish and Game has endeavored to, through research, common sense and hard work, to meet and solve today's problems. At the same time it is attempting to anticipate those of the future. California's wildlife heritage of today is worth hundreds of millions of dollars annually to present residents of the State. With an intelligent program for the future, carried out by an enlightened citizenry, the value of that heritage to

generations of Californians yet unborn can be immeasurable.

### Departmental Reorganization

During the past two years the Department of Fish and Game has been undergoing a sweeping reorganization, involving decentralization and reorientation of functions and operations. As set up by the Fish and Game Reorganization Act of 1951, the former Division of Fish and Game became the Department of Fish and Game with a director, appointed by the Governor, in full charge of all administrative operations and personnel. At the beginning of the biennium, there still was much to accomplish in the implementation of the reorganization act, such as appointment of regional managers, heads of the various staff functions, setting up of physical facilities both in the field and at central headquarters.

Through competitive examinations, interviews, and careful screening, the most qualified men available both in California and elsewhere were selected for new positions in the department. Former bureau chiefs were assigned to staff duties as heads of four new branches. They were: Ben Glading, Game Management; Alex J. Calhoun, Inland Fisheries; Richard S. Croker, Marine Fisheries; and E. L. Macaulay, wildlife protection. All are veterans of California Fish and Game. Regional managers chosen were James D. Stokes, Region I at Redding; Robert D. Montgomery, Region II at Sacramento; Robert L. Jones, Region III at San Francisco; William Morse, Region IV at Fresno; and John F. Janssen, Region V at Los Angeles. Near the end of the biennium Phil Roedel, formerly of the Terminal Island Laboratory, became Manager of Region IV.

Primarily, the purposes of the reorganization were to do a more businesslike job, to assure maximum results for the funds expended, and to bring administrative responsibility as close as possible to the people being served.

Physically, this entailed moving the headquarters from San Francisco to Sacramento, establishment of the five regional offices, and integrating the work and functions of the various field stations with their regional administration. Each regional manager has complete control of all operations, manpower and equipment under his jurisdiction, with the exception of Marine Fisheries and some research functions.

### Policy-making Functions

Under the reorganization act, the Fish and Game Commission continued its highly important policy-making and regulatory functions, with the director administering the department in conformance with those policies.

Regional offices have relieved the central staff of enormous volume of administrative work, allowing time to be properly spent in planning and research. The hunting and angling public now can call upon five regional operating staffs familiar with the problems of the locality, and coordinated with a headquarters group responsible for state-wide planning and research. Through decentralization, local supervisors of the various functions are located in the field where they can take action based on intimate knowledge and field work. Under the old system all of the top specialists were located at central headquarters in San Francisco with no coordination on the field level.

Administratively, streamlining of the Fish and Game accounting office has made possible better budgeting and distribution of budget status reports to the operating and staff functions early each month. This furnishes the various functional supervisors current information on expenditures and availability of funds, so that programs can be carried out efficiently.

Among other major accomplishments of the reorganization on a line and staff basis was establishment on October 1, 1952, of a functioning conservation education section at staff level, of a separate business function, a change-over to a central pay roll system, including the decentralization of personal records, decentralization of the licensing functions, setting up of a water projects and pollution section apart from the branches, an engineering section centrally directed, headquarters auto pool, central files, and a stenographic pool.

The department's reorganization plan is the practical application of policies and practices long adhered to by successful business organizations. In public affairs in general, and within the California Department of Fish and Game in particular, the aim is application

*Game farms and most other management activities now are handled by the regions. This is a view of the pens at China Game Farm.*

of the same delegation of authority and fixed responsibility for results. Especially important is the bringing of that delegated authority close enough to those who are served, to resolve on the local level many of the frictions and misunderstandings which cause grief and loss of efficiency, particularly in the field of wildlife conservation.

### Drain on Reserve Decreases

A major concern during the biennial period was the problem of bringing expenditures in balance with revenue. Marked progress was made in this direction.

An overdraft of $340,000 for the Fiscal Year 1951-52 was made on the Fish and Game Preservation Fund reserve of $6,124,499 which had been accumulated during war years. The overdraft occurred before reorganization was undertaken and generally resulted from expansion of maintenance, operation and service activities outlined as essential to preservation, protection and restoration of California wildlife resources by the Wildlife Conservation Board in its report of May, 1950.

Through the 1952-54 Biennium during which reorganization and decentralization took place, increases in maintenance, operation and service expenditures continued with the opening of more new hatcheries, new waterfowl management areas, increase in cooperative hunting acreage management, hunter safety program and other similar activities. Such increased expenditures were kept at a practical minimum and the reorganized department was able to absorb much of these activities with existing personnel. Improved efficiency of operation also was credited with helping to reduce the overdraft of $260,648 recorded at the end of the 1953 Fiscal Year and the further reduction of the overdraft to $152,663 at the end of the 1954 Fiscal Year.

This closing of the gap between expenditures and revenue was accomplished during a period of rising revenue, true, but the increased number of dollars received was more than offset by the loss in value of those dollars resulting from inflation.

Whether providing new services and absorption of new operations by the existing organization had reached its limit, and whether the point of maximum efficiency under the reorganization plan had been reached during the biennium could not be definitely established.

### Fish and Game Commission

Importance of the five-member Fish and Game Commission as a policy-making body, and in providing strong leadership in the State's conservation program, was highlighted during the biennium by numerous decisions which are having far-reaching effects in both conservation and in providing better hunting and angling opportunities for millions of Californians.

Probably the most important of these was the promulgation of a new system of advance registration and granting of reservations to hunt on state-controlled waterfowl management areas. This matter was studied thoroughly by the commission, and later became established policy and was placed in effect for the 1954 waterfowl season. Believing that the unattached hunter should have an opportunity for advance reservation of hunting dates, the plan was studied from every angle, and presented to various interested organizations for review. Granting of reservations was to be made by lot, with any vacancies to be filled on a first come, first served basis.

Regulations governing cooperative hunting areas were streamlined to assume more efficient management, and to add areas which formerly could not qualify for lack of size.

Sweeping amendments were made in existing pheasant policies and new ones inaugurated to improve hunting, and at the same time to effect economies in pheasant planting.

The commission set up a priority system for planting of birds raised on Department of Fish and Game bird farms, with top priority on the basis of access by the general public. A policy of providing as many shootable birds without expansion of the game farms was adopted.

### Fighting for Existence

Recognizing that several species of important commercial ocean fish are literally fighting for their existence in the face of heavy pressure, the commission continued to press for a legislative program for authority to control the catch of sardines, anchovies, Pacific

*An advance registration system for waterfowl hunting areas was set up by the Fish and Game Commission to eliminate long waiting lines like this one at Colusa Refuge.*

mackerel and jack mackerel as a fundamental resource management tool. Its program along this line failed to materialize by July, 1954. Public knowledge of the condition of these resources increased materially during this period and interest in protecting and maintaining the species intensified.

At the same time members of the commission stood firm on important policies designed to protect the ocean fishery offshore. Its policy on oyster bed allotments was strengthened, as was the regulation on control of oyster pests in imports.

It denied permits for reduction of ocean fish as a conservation measure, although permits for reductions of specified ocean trash fish were granted.

Continued scrutiny and strengthening of regulations concerning offshore blasting in seismic explorations were carried on during the biennium.

In the implementation of its deer management policy, adopted the previous biennium, the commission laid down rules and regulations for special deer hunts, and decreed that various groups or individuals asking for such special hunts prepare supporting evidence to back their requests at public hearings.

As a result of a ruling by the Attorney General, the commission abandoned its former policy concerning planting of state-raised trout in certain private waters of the State. Previously the commission had required that owners of such private waters open at least a third of their shore line to public fishing after state fish were planted, but the opinion held that the commission was without authority to impose this requirement.

Two new members of the commission were appointed during the biennium, including Harley E. Knox, former Mayor of San Diego, succeeding Harvey E. Hastain of Brawley, and Weldon L. Oxley, insurance executive of Redding, succeeding Paul Denny of Etna. William J. Silva of Modesto served as chairman during 1953 and 1954. Other members of the commission at the biennium's conclusion were Carle F. Wente of San Francisco and Lee F. Payne of Los Angeles.

SKY-SCRAPERS WASTE BIRDS AND AMMUNITION!
50 YARDS... AND BEYOND YOUR SHOT IS 20% EFFECTIVE OR LESS
40 YARDS... YOUR SHOT IS 80% EFFECTIVE
30 YARDS... YOUR SHOT IS 100% EFFECTIVE
SKY-SCRAPERS WOUND AND DESTROY MORE BIRDS THAN HUNTERS TAKE HOME
12 GA. #5 SHOT FULL CHOKE
DON'T BE A SKY-SCRAPER!
STATE OF CALIFORNIA DEPARTMENT OF FISH AND GAME

*Educational posters like this one help prevent wasteful long range shooting of waterfawl. This sign is posted at all public shooting areas.*

### Conservation Education

An important step in strengthening wildlife conservation in California during the biennium was the coordination and realignment of the department's entire conservation education program.

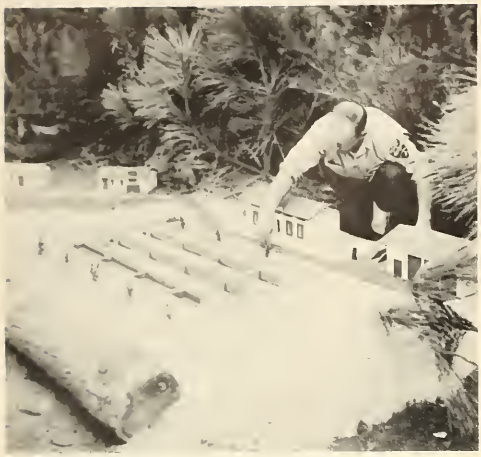
It is based on the concept that ignorance and greed are the two major enemies of wildlife, and an informed public is the surest weapon with which to defeat these twin enemies.

The new conservation education program of the Department of Fish and Game is designed to make available comprehensive information on California's wildlife resources to as many people as possible, through funds provided by the users of the resource themselves. Although these funds come from hunting and angling license holders and from commercial fishermen, the wildlife resource belongs to all of the people of California and the conservation education program is designed to reach all of them.

The conservation education section was planned as an important segment of the reorganization plan completed near the close of the last biennium, although the section did not actually come into full operation until early in 1953 when Robert D. Calkins, Modesto newspaperman, was appointed as first conservation education director.

### Conservation Education Activities

Activities of the section included dissemination of information concerning general status and condition of California wildlife, notices of open seasons, regulations, conservation measures, and policies of the Fish and Game Commission and the department. This was accomplished through releases, to newspapers, radio stations and television stations, distribution of the



*Exhibits are among the media for conservation education. This hatchery model was shown at the California State Fair.*

monthly bulletin *Outdoor California* to license agents, officials of organized sportsmen's groups, and others whose positions require an up-to-date knowledge of conservation matters, servicing of outdoor writers, providing abstracts of angling and hunting regulations, publications of angler's guides to promote fishing in areas where heretofore pressure has been light, publication of pamphlets on various species of fish and game, providing information to schools and civic organizations and explanation of various cooperative and public hunting programs.

In addition the section mailed more than 100,000 pieces of literature in response to direct inquiries from throughout the State concerning conservation and wildlife questions, and distributed nearly 2,000,000 pieces of literature through license agents and other outlets.

Another development of importance was the visual aids program, in which seven motion pictures suitable for showing both at public meetings and for television were produced. Old film already on hand was revised and edited and two entirely new films were under way at the close of the biennium. Other visual aids included exhibits for use at fairs, sports shows, and organization gatherings. Also operated by the conservation section is the library which contains conservation materials for use of the staff, research people, and sportsmen.

One basic change in the program was elimination of a procedure under which conservation pamphlets were produced for distribution, on request, to schools throughout the State for elementary classroom use. This was on the recommendation of the Senate Interim Committee on Fish and Game.

### Publications on Sale

Another major change was that of a revised distribution policy and reduction in size of the California Fish and Game scientific quarterly publication, and placing of many department publications on sale at cost. It was estimated that many thousands of dollars per year in new revenue will be realized from the sale of departmental printed materials. A portion of the savings realized by reductions and cutbacks in technical publications was placed into the new monthly bulletin *Outdoor California.*

Total expenditures of the section during the first full 12-month period of full operation were $151,309, or 2 percent of the total department expenditure for the period. This represented a cost of about one cent per citizen. This percentage is the lowest of any comparable states, whose wildlife resources are far less valuable than those of California.

### New Program Organized

During the biennium the section organized and supervised a new program for hunter safety training pursuant to action by the California Legislature. The new law required that each hunter under 16 who had not previously held a license must obtain a certificate of competence in handling firearms by taking a course of instruction supervised by the department. The hunter safety training program of the National Rifle Association was adopted and the NRA contributed its services in developing the California program.

Efforts were continued to interest school administrators and curriculum people in bringing conservation instruction into the public schools of the State. At present conservation is not recognized by state law as a subject required in the curriculum, and there are relatively few teachers trained to teach the subject. The conservation education director became an active member of the Conservation Education Committee of the Department of Education during the biennium.

With California leading the Nation in rate of license increase, and in decrease of wildlife habitat due to agricultural and urban encroachment, the need and demand for conservation education activity has spiraled since World War II, and will continue to increase if the human pressure on wildlife continues to increase.

## WILDLIFE CONSERVATION BOARD

In accordance with a request of the Fish and Game Commission in January, 1954, the Wildlife Conservation Board concentrated its activities on completion of existing projects, and financing new projects requiring low operation and maintenance costs when completed.

The commission at that time requested that the board not approve additional projects which would impose appreciable outlays for operation and maintenance until the Department of Fish and Game had

balanced its budget, or additional operating funds were made available.

During this biennium the last $2,000,000 appropriated by the Legislature became available for expenditure, making a total of $12,000,000 in capital investment for fish and game from the State's share of the pari-mutuel Horse Racing Fund.

Eleven new projects were approved and allocations made. Of these two were projects previously approved, from which funds allotted had been withdrawn. In addition funds were allocated for improvement, development, or expansion of six existing fisheries projects and two waterfowl developments. Ten projects were completed during the biennium.

A second policy change was the decision to acquire property through negotiation, without condemnation, by the Department of Fish and Game. This decision was made after the Attorney General advised that such action was within the scope of the Wildlife Conservation Act.

### Changes of Board Membership

Vacancies on the Wildlife Conservation Board Joint Legislative Advisory Committee caused by the deaths of Assemblyman Lester T. Davis and Senator George J. Hatfield were filled by appointment of Assemblyman Frank P. Belotti and Senator Ed. C. Johnson. Other members of the joint committee were Senators Ben Hulse and Charles Brown, and Assemblymen Thomas M. Erwin and Lloyd W. Lowrey. Department of Finance Director John M. Peirce replaced James S. Dean, retired, on the board, and Wm. J. Silva, President of the Fish and Game Commission, served as chairman of the board during the biennium.

### Fish Hatchery and Stocking Projects

Darrah Springs Hatchery, among the largest in the United States, was completed and placed in operation. Mt. Shasta, Crystal Lake, Moccasin Creek, Fish Springs, Hot Creek, and Mojave Hatcheries were in full production. Hot Creek Hatchery and Black Rock Rearing Ponds were being further expanded to increase production with but small increase in operating costs.

An allocation of $40,000 was made for land acquisition for a proposed hatchery on the American River below Nimbus Dam. Land is to be provided by the Federal Government and $10,000 of the $40,000 was authorized to enlarge the outlet pipe from Nimbus Dam to the federal salmon hatchery, to permit carrying adequate water for an adjacent state trout hatchery, if and when it becomes desirable. There were no immediate plans laid to construct this trout hatchery until the actual need for an additional hatchery in this section of the State is fully demonstrated.

Tahoe Hatchery expansion was held in abeyance pending the outcome of the present catchable trout program. Possibly the needs of this area can be served better and more economically by the American River Hatchery.

San Joaquin Hatchery on the San Joaquin River below Friant Dam and Cedar Creek Experimental Hatchery in northern Mendocino County were being constructed.

After intensive search for an alternate site for the San Gabriel Hatchery, the board decided to wait until contemplated and existing hatcheries were in full operation before further action would be taken.

### Stream Flow Maintenance and Improvement

While only two projects are recorded as completed during the biennium, good progress has been made on others and work is still proceeding. Initial allocations of funds for such work in Fish and Game Regions II, IV, and V were nearly exhausted and requests for additional funds were to be made based upon recent surveys.

### Waterfowl Projects

The Wildlife Board revamped its waterfowl management area development program. Because of an excessive value placed upon San Luis Island by the court, this project was dropped. Of the seven key waterfowl management areas originally to the board proposed, Butte Sink, Lower and Upper San Joaquin Valley, and Madera Waterfowl areas were canceled and the balance of unexpended funds transferred to one authorized project in the Central San Joaquin Valley.

One new unit of the Imperial Valley Waterfowl area, to replace lands inundated by the continued rise of Salton Sea, was authorized and funds for its acquisition allocated. Acquisition of the land is progressing.

This reduced the key waterfowl management areas proposed for purchase by the board to four.

See Appendix for status of Wildlife Conservation Board Funds.

*Rearing ponds at Darrah Springs Hatchery, largest trout installation in the State.*

## STATUS OF WILDLIFE RESOURCES

During two years of tremendous, unprecedented hunting and fishing pressures, California's wildlife resources appeared to be holding their own, and in some cases making numerical gains. In most cases encroachment on natural habitat, pollution of streams, and skyrocketing demands for water posed the greatest threats to wildlife. Where natural conditions were good, the hunter or fisherman did not make dangerous inroads on the supply.

As the new biennium started, however, every effort was being made to further improve efficiency of operation to bring expenditures of the department even with income.

At the end of the biennium, the Fish and Game Preservation Fund reserve stood at approximately $5,371,000.

Another major factor in maintaining existing populations of wildlife has been the work of the wildlife protection personnel in the prevention of violations through conservation education of the public, and in the apprehension of violators.

The deer kill fell off after the severe winter of 1951-52, but during the 1953 season the bag climbed back to the second best year on record.

At the end of the biennium deer numbers were on the increase virtually throughout the State. Two mild winters which made for good feed conditions was one of the major factors in the increase. Special deer seasons were held during the biennium where material crop depredation or pasture damage was being done, or where local interests requested special hunts, and backed their request with proper evidence. Investigative work continued on deer browse and range conditions, and other matters pertaining to good deer management.

*Observation by the department showed that there were enough sturgeon to warrant an open season beginning in April, 1954.*

### Good Populations

Surveys have indicated extremely good populations of quail, doves and pheasants. Ducks and geese remained at high levels, and record bags were reported during the biennium.

In addition to the virtual disappearance of the sardine off California, weak spots developed in several other categories of the ocean fishery. The take of Jack and Pacific mackerel and anchovies declined alarmingly, and only the younger fish predominated. Sports fishing continued to grow, especially the salmon sports fishery which is beginning to rival the commercial catch in economic importance. Efforts of the department brought about beginnings of new shrimp and oyster fisheries for California.

During the two-year period the planting of catchable trout in roadside streams and lakes reached new highs, as did aerial planting of fingerlings, but at the same time continued efforts were made to improve streams as natural habitat for wild fish. Experiments were carried out to introduce new forage fishes for the warmwater species. Salmon and steelhead runs held fairly steady, and numbers of sturgeon increased to the point that an open season was declared late in the biennium, the first in 36 years.

### Wildlife of the Future

While the department was occupied during the biennium with reorganization, meeting increased demands on wildlife by hunters and anglers, accelerating the hatchery program, wildlife habitat acquisition and improvement, the problems of California's future fish and game needs played a highly important role in department thinking.

As departmental reorganization freed headquarters staff members from various operation duties, planning for the future was crystallized into a 10-year plan for meeting future needs of both wildlife and holders of hunting and angling licenses.

Improved research and intensified field investigations continued to point up new and better ways of further expanding wildlife production in its natural habitat. So far only the surface has been scratched; much more can be done.

The best use of fish, game and other wildlife resources can be realized only if the people have the opportunity to get where these resources are located. The average citizen should have access to uncrowded places which he can enter legally to enjoy wildlife in the manner of his choosing, without too much cost and effort. On the other hand, an ample number of remote-hard-to-get-to wilderness areas should be reserved and maintained for those willing to exert themselves enough to reach them.

### Not All Available

Only 40 percent of California's land is readily available for public use today, and much of this is remote, rough country. Similarly, only a portion of California's existing wildlife is available for wise use. The term "wise use" is not confined solely to licensed fishermen and hunters. All Californians, now and in the future, should have the opportunity of enjoying their wildlife resources. Students of nature, the photographer, the skin diver, disciples of Audubon, and millions of other citizens who do not actually "harvest" wildlife, all have an equal right to share in this great heritage, and it should be made available to them.

Today fish and game of California is sustaining a resource which at the end of the biennium was putting an estimated $720,000,000 annually into California's economic bloodstream by sportsmen in their pursuit of wildlife. In addition commercial fishing, fur trapping and allied industries were pumping another $280,000,000 into California business life.

Even the most conservative estimates show that in 1965 the State will have 2,580,000 license holders. But experience has shown that the number of license holders increase more rapidly than the population, and for that reason the number of fishermen and hunters may reach 3,000,000 by that time.

### Ceiling Not Foreseeoble

These projections are based on estimates of population increases, made by the Department of Finance and on the historical average percentage of increase in license buyers over a 25-year period. There is nothing in the record to indicate what the ceiling might be. Loss of fish and game, or lack of opportunity to make wise use of the resource, are the only factors which might materially change the above predictions.

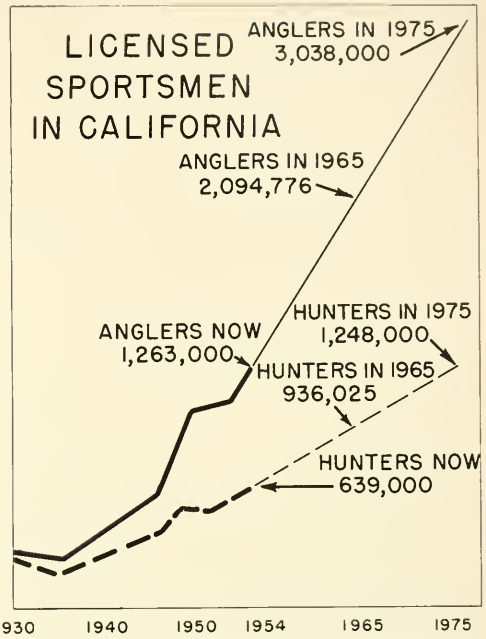
Now as to the past, future, and proposed expenditures, this is the situation. From 1945 through the fiscal year of 1955 approximately $62,050,000 will have been spent for wildlife.

In this connection it should be noted, that except for $12,000,000 made available from pari-mutuel revenue, all of the above funds have come from buyers of licenses, special tags (i.e., deer and pheasant tags), commercial fishing taxes, etc.—none from general tax revenues.

If income for fish and game welfare for the next 10 years continues from present sources at current rates, and is projected on the accelerating line of license buying increase, there will be available from 1955 through 1956 a total of $93,500,000.

Considering an average annual $9,350,000 income foreseeable from the present rate base, the expenditure to service and sustain the billion dollar industry for the next 10 years is less than 1 percent annually.

All signs point to the probability that wildlife will not hold up under the anticipated pressures of the next




*License buyers have been increasing at a faster rate than the population. Above is a projection of what faces the State's wildlife resources in the future.*

10 years with the relatively small investment now being made to sustain it. The present investment will be absorbed simply in providing minimum services to the new customers at present levels. Increasing numbers of customers with the increasing hunting and fishing pressures will definitely result in demands and needs for more and improved operation services—more fish and game wardens, more wildlife field men, more information and education, more people to handle the housekeeping chores of administration, plus additional equipment. Some of this increased operational load no doubt can be readily absorbed by the income from new customers. But there's no point in ignoring the fact that some of the present services of Fish and Game administration could well be further improved. And as the population increases new services will be needed and demanded by the people.

Over the years certain expansions in personnel have been unavoidable. For example, when federal aid funds became available 15 years ago, a sizeable group of new employees was added. Recently, with the addition of new functions, especially operation of expanded facilities provided by the Wildlife Conservation Board funds, additional employees were necessary to man them.

## SUMMARY OF COSTS FOR 10-YEAR PROGRAM

| | *Estimated cost of recommended project* | *Estimated annual operation and maintenance costs* |
|---|---|---|
| Marine fisheries | $7,100,000 | $65,000 |
| Inland fisheries | 11,500,000 | 795,000 |
| Salmon and steelhead program | 3,950,000 | ------- |
| Sub-total for fisheries improvement | $22,550,000 | |
| Hunting opportunities | 20,000,000 | 2,700,000 |
| Economic survey | 15,000 | ------- |
| Totals | $42,565,000 | $3,560,000 |
| Average per year | $4,256,500 | $3,560,000* |

* This represents estimated annual cost of operating fully developed program. During period of development, the operating costs will be approximately half of the ultimate cost of operation.

Near the end of the biennium a study of the work load and operation of the warden staff was set up. The shorter work week, new responsibilities such as the hunter safety training program, patrolling new public shooting areas, new legislation and the constantly increasing army of anglers and hunters, as well as others who flock to the outdoors, have materially increased each warden's daily task during the past 10 years.

This is the one group of specialized fish and game workers that has remained more or less static in numbers for more than a decade.

### No Cost Estimate for More Service

No estimate of cost to raise the current level of service is included in the proposed 10-year plan, all of which is outside of the presently scheduled fish and game program. However, attention is called to the fact that the Fish and Game Commission has gone on record as being opposed to further capital investments in new facilities, or expansions of services, until operating funds are assured.

In order adequately to meet and solve the problems ahead, the people responsible for wildlife have outlined a series of steps which can be taken during the next 10 years to perpetuate and make California wildlife available to maximum numbers of its people.

The proposals summarized in the appendix, Table 6, represent the combined thinking of sportsmen, businessmen and others vitally interested in wildlife, as well as the thoughts of the fish and game workers who are hired by the people as custodians of California's wildlife resources.

## WATER PROJECTS

Most people are gradually realizing the importance of fish and game to the economy of California but it is more difficult to realize that this tremendous asset is completely dependent upon an adequate water supply. The future of these resources appears bleak unless their importance in future California water development plans is realized.

The Fish and Game Commission's water policy has recognized that California's expanding population must work and eat but that it is equally essential that outdoor recreation be provided for the well-being of this expanding population. There also is a tremendous food resource involved which can be self-perpetuating if fisheries are wisely managed.

Many old water developments were constructed with no consideration for fish and wildlife and the Department of Fish and Game is actively trying to rehabilitate streams which have been dried up for many years, by securing flow releases.

California's waterfowl are suffering in a similar manner and the millions of acres of natural marsh in the Central Valley have been reduced to perhaps 100,000 acres. As a result, serious crop depredation problems have occurred as these birds use agricultural land.

### Establishment of Water Projects Coordinator

Early in 1953 a new function was undertaken by the department with a staff section being made responsible for water problems relating to wildlife. Work of this section is largely planning for the future of fish and game in California. It is also attempting to rehabilitate the many streams which have been affected by diversions which were built many years ago when no consideration was given to maintaining stream flows for fishing and recreation.

In 1953 the department was successful, for example, in securing water release below Florence Lake Dam on the South Fork of the San Joaquin River in Fresno County in cooperation with the Southern California Edison Company. Ever since this dam was built in the early twenties summer stream flow has been inadequate to allow the development of a trout fishery for the many thousands of people who now visit this area yearly. Release of 10 cubic feet per second into this stream will allow the Department of Fish and Game to develop this easily accessible area to meet increasing recreational need.

Water problems are not confined to fisheries alone. The future of waterfowl in the Pacific Flyway depends to a large extent on securing land and water for wintering areas. Concern of agricultural groups is well appreciated and crop depredations pose a constant threat. Land which has formerly been used by waterfowl is being reclaimed for agriculture. This is another case where a relatively small amount of water can pay real dividends if it is available when needed on waterfowl management areas and other natural habitat areas.

### The Grasslands Problem

In 1952, for example, a serious crop depredation problem developed in the lower San Joaquin Valley. No relief was afforded by herding because the birds simply moved to another rice field and continued to cause severe crop losses. In this case a small amount of water was secured from the Bureau of Reclamation for flooding in the grasslands area.

### State Economy Benefits

As soon as these lands were flooded the department was able to herd the waterfowl off agricultural lands successfully into flooded areas. Cost of the water in this case was very minor compared to value of the crops which were saved. By using this water for ducks the economy of the State received a much greater benefit in agricultural production than the same amount would have produced if used for irrigation. A major victory toward obtaining water for waterfowl was the passage of the Grasslands Bill.

During the past two years the Department of Fish and Game has begun to actively participate in the planning of water developments in cooperation with the public and private agencies who are now making the plans to meet the future water needs of California.

Under the terms of Public Law 732 (the so-called Wildlife Resources Act of 1946), the department may submit recommendations to the Federal Power Commission for protection of fish and wildlife resources affected by the construction of federal projects or projects under federal license. By working with the public utilities it has been possible to have these recommendations included in all licenses for power development which have been issued in the past two years. These have included new power projects under construction on the Feather, American, Stanislaus, Kings, and San Joaquin River watersheds.

Of even more importance are major developments proposed in the past two years which are now under active study by the Department of Fish and Game. Major water projects have been proposed for nearly every watershed in the State.

The department also conducts active programs in cooperation with the other conservation agencies working in California. The U. S. Fish and Wildlife Service, for example, has an active program as do many other federal agencies, such as the Bureau of Reclamation, Corps of Engineers, Forest Service, and the Soil Conservation Service. Nearly every land and water development program has serious implications

for California's fish and wildlife and it is essential that the protection of these resources be included in any plan of development.

### Encouraging Development

One encouraging development of the past two years has been the recognition of the importance of fish and wild life by the Legislature and other state agencies. In 1953, for example, the Legislature added Sections 526.5 and 526.6 to the Fish and Game Code. These measures insure that future water developments in Mono and Inyo Counties will not jeopardize the fisheries resources either by drying up the stream or by operating power generation facilities in such a manner as to fluctuate stream flows below the dams.

The department has been actively participating in the State's study of the feasibility of a salt-water barrier in the Delta. The proposal to build such a structure to prevent the intrusion of salt water and as a water conservation measure may seriously jeopardize the Central Valley salmon, steelhead, and striped bass fishery.

It is possible that the barrier could eliminate these fish entirely. Value of the fisheries must be included in costs of the project before such a barrier is built. The department has made economic evaluations of these fisheries resources and has been actively designing fish protective facilities in the event such a barrier is found feasible. This is the first time that technical fisheries personnel have been assigned to work with engineers of the Division of Water Resources in such an investigation.

In addition, the department has reviewed all applications to appropriate water filed with the State Division of Water Resources. Cases in which there is a definite threat to the welfare of fish, are protested by Department of Fish and Game with a statement of conditions under which the protest can be withdrawn.

*An example of what pollution can do to the State's fisheries when left uncontralled.*

During the past biennium 1,055 applications have been investigated by the department and 62 protests were filed. Only one formal hearing was required and in all but 12 cases, which are still pending, the department's protest has been upheld and the permits for diversion contain a clause specifying that certain minimum flows will be bypassed below the point of diversion at all times.

### Pollution Control

Unprecedented growth of California has continued and water pollution control agencies are faced with a major problem of protecting the State's water from pollution. The department, in cooperation with the other pollution control agencies, has continued its program of protecting fish and wildlife and has investigated over 700 applications for waste discharge. Recommendations were submitted to the Pollution Control Board in all necessary cases.

Major interest in pollution control has centered on the many new industries which are proposing to locate in California. Most of these new plants present industrial waste problems which are new to California, such as the pulp and paper industry. Importance of waste disposal has tended to be neglected in industrial location studies in the past and the department is actively undertaking a program to point out the importance of protecting fish and wildlife before the industrial plants are constructed.

Fortunately, no serious fish mortalities have occurred during the past two years. There are still many locations in the State where additional waste treatment facilities are needed before adequate protection can be given to our aquatic resources, particularly in those areas where seasonal food processing wastes contribute the major portion of the pollution load.

The department also has intensified its program of law enforcement and technical investigations of water matters. For example, the San Francisco region has assigned one of its wardens to full-time work on pollution problems. Technical investigations have included long-range surveys to determine the effect of the increasing industrial waste load in the Carquinez Straits area and on the Central Valley salmon streams.

The continuing pollution control program on the upper Sacramento River has been intensified. Drainage from abandoned copper mines and slag deposits poses a serious threat to the fisheries resources of the Sacramento River. An investigation of all possible sources of pollution has been completed and it has been found that these discharges do not pose a serious threat to the Sacramento River with the present flows. However, it is quite possible that serious fish mortalities could result if the flow was reduced at the time of high runoff in the Spring Creek drainage, in Shasta County.

# WILDLIFE PROTECTION

*Arrests increase 27 percent over previous biennium.*

*Technical equipment increases effectiveness of warden staff.*

*Reserve warden program expanded.*

*Hunter safety training program carried out by branch.*

## WILDLIFE PROTECTION

Of all the activities of the department, probably none was so directly affected by the huge increase in hunting and angling license holders during the biennium as was the Wildlife Protection function. The increased work load was brought about by the greater numbers of hunters and fishermen on almost every section of California's more than 150,000 square miles and its 1,200-mile coastline, and by the addition of a new activity, the hunter safety training program.

Increased hunting and fishing activity was reflected in a 27 percent increase in the number of arrests over the previous biennium. Addition of patrol boats, communications equipment and more use of aerial patrol and reconnaissance bulwarked operations of the branch.

Departmental reorganization brought administrative changes in that the assistant chiefs of patrol, formerly in charge of six patrol districts, were assigned as wildlife protection supervisors, reporting to the five regional managers. Marine Patrol, headquartered at Terminal Island, reported to Region V. All members of the Bureau of Patrol, with the exception of the Chief Staff Officer, Wildlife Protection Branch, one staff assistant, and a clerical assistant, were transferred to the various regions in January, 1953.

### HUNTER SAFETY TRAINING PROGRAM

Faced with several years of mounting hunting casualty lists, and the prospects of even more hunters in the field in the future, the 1953 California Legislature enacted a measure, now embodied in Section 424 of the California Fish and Game Code, providing that * * * "no hunting license shall be issued to any person under the age of 16 years unless he presents * * * either evidence that he has held a hunting license in this State during a prior year, or a certificate of competency as provided by law. * * *"

Intent of the act was primarily to prevent hunting casualties which annually mar the sport, to prevent many gun accidents not directly resulting from hunting activity, and secondarily, to instill in the young hunter the principles of conservation, good sportsmanship and proper conduct in the field.

Prohibitive measures designed to prevent accidents had long been on the books but still the number of casualties increased in direct proportion to the number of untrained people in the hunting field. However, in New York, where a hunter safety program based on education and legislation requiring junior hunters to present evidence of competency to handle firearms, a decrease in casualties of 75 percent was recorded during the five years prior to 1953.

The original bill was introduced by Assemblywoman Pauline Davis of Portola, and a companion measure introduced in the Senate by Senator Pressley Abshire of Sonoma.

Under terms of the legislation, to go into effect with issuance of 1954-55 hunting licenses, the Director of the Department of Fish and Game was assigned the task of translating the measure into action. Administratively, the function was assigned to the Conservation Education Section, with the field work to be accomplished by members of the warden staff. Work of preparing the program began in the fall of 1953 and some classes were graduated in March of 1954. Legislation also provided that the department could cooperate with any reputable organization whose purpose is promotion of gun safety.

#### Ideal Safety Course

Consideration of material available showed that the National Rifle Association of America hunter safety course was ideal. It required only four hours of instruction for the student, utilized the services of volunteer instructors qualified by NRA and approved by the department, and excellent textbooks, reference materials and charts were available at low cost and on short notice from the National Rifle Association.

The department approved the recommended course of training, and an agreement was made with NRA to certify and service instructors, provide materials at cost to instructors and report to the department the number of instructors qualified and students trained.

Response to the new program was immediate and enthusiastic. Sportsmen's and educational organizations offered wholehearted cooperation from the start. All Wildlife Protection Branch personnel were qualified as hunter safety instructors and instructional materials prepared by the headquarters conservation education staff.

At the close of the biennium, when certificates of competence were first required, 3,195 hunter safety instructors had been certified by NRA, and about 1,000 junior hunters trained and ready to present evidence of competency as required by law for the 1954 hunting season. Indications were that 15,000 to 20,000 juniors would be checked out during the 1954 hunting season.

The junior hunter is taught reasons for the course, and is shown that all hunter casualties stem from either ignorance or carelessness. Next step is the mechanics of shooting safely, and acquisition of a working knowledge of weapons and their proper care.

He also hears discussion of danger of becoming lost in the woods and how to conduct himself if lost, fish and game laws with emphasis on the intent of conservation measures, safe hunting techniques, fire pre-

*Training and refresher courses are maintained for the warden staff.*

vention, leaving a clean camp, and proper conduct in the field. Also stressed is the need for improved relations between the sportsman and landowner, and finally, the concept that the individual hunter alone can prevent accidents. A final written examination and demonstration of safe gun handling completes the course. When possible the student fires 15 rounds of .22 caliber ammunition under supervision of the instructor.

Wildlife Protection Branch personnel made use of the department manual, hunter safety films, "Shooting Safety," "Trigger-Happy Harry," and "The Making of a Shooter," and other materials. Wardens not only contacted interested groups, but stimulated interest where it was lagging, contacted instructors already certified, helped integrate the 3,500 license agents into the program, assisted in local publicity for the program, and worked with sportsmen's groups.

To create a uniform system of training, an instructor training course was developed by the department in cooperation with the Alameda Adult School and the western representative of the National Rifle Association. The State Department of Education approved the instructor training course for adult classes and at least 30 communities held hunter safety classes. Many schools participated in the program.

Cooperation from every type of organization was forthcoming, and much of the credit of a successful start of the program goes to these public spirited people.

## ENFORCEMENT ACTIVITIES

Arrests by Fish and Game wardens during the biennium totaled 16,271, or an increase of 27 percent over the previous two-year period, with more than one-third relating to inland fishing.

Average fine levied by the courts in fish and game violation cases was $37.09, or a total of $598,588.14. Convicted violators were sentenced to serve a total of 12,836 days in jail. Significantly, the percentage of cases dismissed by the courts, or in which the defendant was found not guilty after a trial, was only .75 of 1 percent. (See Table 9, Appendix.)

During the biennium three years of undercover work by game management agents of the U. S. Fish and Wildlife Service and Department Wardens was climaxed with the conviction of 12 Sacramento Valley waterfowl market hunters and seven San Francisco Bay restaurant operators. In federal court they shared sentences totaling six years and nine months in jail, $4,900 in fines, and seven years of probation. Federal Judge Oliver J. Carter, in passing sentence on the market hunters, stated that the violators were victims of the unwillingness of their communities to respect the fish and game laws, believing that the crime is in being caught, and not that a wrongful act had been committed. He further stated that the ring leader was raised in an attitude of complete moral blindness on the question of game laws, a matter for which his community was partially responsible.

The arrest and violation figures tell only part of the story. Hundreds of thousands of miles covered by automobiles, boats, airplane and on foot checking hunters and fishermen are a part of it. Many day and night hours spent waiting for violators to return to their illegal nets, obtaining evidence, inspecting catches, arresting poachers, and countless other details complete the major portion of the picture.

Wardens also have contributed major assistance in the catchable trout planting program, followed by intensive patrol in the newly planted areas. The patrol has cooperated in fish rescue work, cleaning and inspection of fish ladders, inspection of stream flow maintenance dams and regulated the flows therefrom.

Members of the warden staff have worked with other functions by reporting suspected fish and game diseases to local headquarters, and in census taking, fish population trends, pollution control, public use, and success in hunting and fishing areas.

They worked closely with farmers during the biennium on crop depredation reports, waterfowl herding and other activities relating to crop damage by wildlife.

But the story of the warden's duties would not be complete without mention of his public service activities. Because of his knowledge of the terrain and experience outdoors, the game warden is called into almost every search for a lost hunter or fisherman in the mountains. He is constantly called upon to speak before sportsmen's and other public gatherings to explain the law enforcement program as well as policies and programs of the department.

Because of his qualifications and experience, other enforcement agencies look to the warden for assistance

in emergencies of all types. Work performed by fish and game wardens in floods, fires, accidents and other emergencies has been notable and varied during the biennium.

In addition wardens made heavy contributions of time and effort in adding to their efficiency with firearms through the medium of pistol and rifle competition throughout the State. At the same time these public matches provided opportunities to acquaint sportsmen with safety measures, and with department programs and literature. These are off-duty activities, with the wardens paying their own entry fees and providing their own ammunition.

Normal duties of the warden staff, as prescribed by the State Personnel Board include responsibility for patrol and investigation involved in enforcement of laws for protection of wildlife, and in prevention of violations.

Other regular duties are apprehension of violators, service of warrants, making arrests, preparation and presentation of evidence in court, investigations and recommendations on requests for permits to keep game birds in captivity, investigation of crop depredations by game birds and animals, inspection of storage plants, boats, restaurants and other places where fish and game may be stored, seizure of illegal bags, and public information work.

## RESERVE WARDEN PROGRAM

During the biennium the activity of the reserve patrol was accelerated, providing material assistance to the regular force in meeting requirements of the growing army of hunters and fishermen in California.

This was particularly true on opening days of the various seasons and heavy hunting and fishing weekends. Reserve wardens are expected to perform at least one tour of duty a month, generally on weekends. However, many of the reserves, who constitute an invaluable service to California sportsmen, put in additional time at night and on week days.

Prospective members of the reserve attend regular weekly training sessions over a 10-week period, and must successfully pass an examination before receiving their appointments. They receive no salary or expenses, and make their tours of duty in company with a member of the regular staff.

Reserve warden leaders were carefully selected during the biennium, and were held responsible for efficient operation of their units. They have not hesitated to terminate appointment of any reserve warden who failed to meet the public with courtesy, consideration, and in a spirit of helpfulness.

At the end of the biennium there were 246 active members of the reserve warden staff, with 12 units operating in the central and southern portions of the State. Units are located at Fresno, Sacramento, Los Angeles, San Diego, Sonora, Terminal Island (marine), Tulare, Merced, Stockton, Bakersfield, and Tulare. Others were in the process of formation at the close of the biennium.

## MARINE PATROL

Aided by the addition of a new 35-foot motor patrol vessel *Yellowtail*, a fleet of 12 patrol boats continued the important Marine Patrol of California's 1,200-mile coastline and its 1,500 miles of inland navigable waters during the biennium. This fleet consisted of the 83-foot *Albacore*, based at Sausalito and covering the coast from there to the Oregon line; the 63-foot *Bonito*, based at San Francisco and working from there south to Morro Bay; the 63-footers *Marlin* and *Bluefin*, based at Terminal Island, whose assignments were from Morro Bay to the Mexican border and around southern offshore islands. Besides these large, well-equipped boats, the Marine Patrol operated eight others, ranging from the 21-foot *Minnow* at Antioch, to the 45-foot *Tuna*, at San Francisco.

The larger boats carry radar, depth finders and other detection equipment. They were supplemented by 25 marine wardens based all along the coastline who maintained a constant patrol of fish markets, canneries, piers, landing places and beaches. During the biennium

*The radio repeater station at White Mountain, Inyo County, part of the communications network.*

*Checking suspicious nets in the Sacramento-San Joaquin Delta is part of the warden's daily routine.*

*Heavy work pressure is on the warden staff during the opening weekends of seasons like deer, pheasants, trout and waterfowl. Here deer tags are checked in the high Sierra.*

marine wardens devoted increasing time to the growing sports fishery as well as to the commercial industry.

Causes for arrests during the biennium ranged from failure to hold a sports angler's license to illegal nets on a purse seiner, boarded at sea under cover of darkness. Checking of commercial landings and cannery packs was another important additional duty. Collection of marine fishery statistics also was carried out by marine wardens during the biennium, assisting in gathering knowledge necessary for intelligent management of the ocean fishery.

## TECHNICAL EQUIPMENT

An increase of radio communications equipment to 296 units during the biennium has added greatly to the patrol efficiency of Wildlife Protection. It has enabled supervisors to contact and direct wardens in the field, wardens to communicate with each other and their headquarters, and patrol airplanes, boats and vehicles to work together as a team.

At the close of the two-year period covered in the report, there were 207 mobile radio units installed in patrol cars, boats and airplanes. There were 52 Handie-talkie units used by wardens while on foot, in small boats or on undercover work where larger mobile units would be impractical. Three portable land stations were available for temporary stations on special hunts, cooperative areas and rush periods. These are effective and practical because of small size and ease of transport and installation. One portable mobile relay station, equipped with its own power supply, was available for use in strategic areas where communications are needed for a limited period only. For location of the 22 permanent land stations, see Table 7, Appendix.

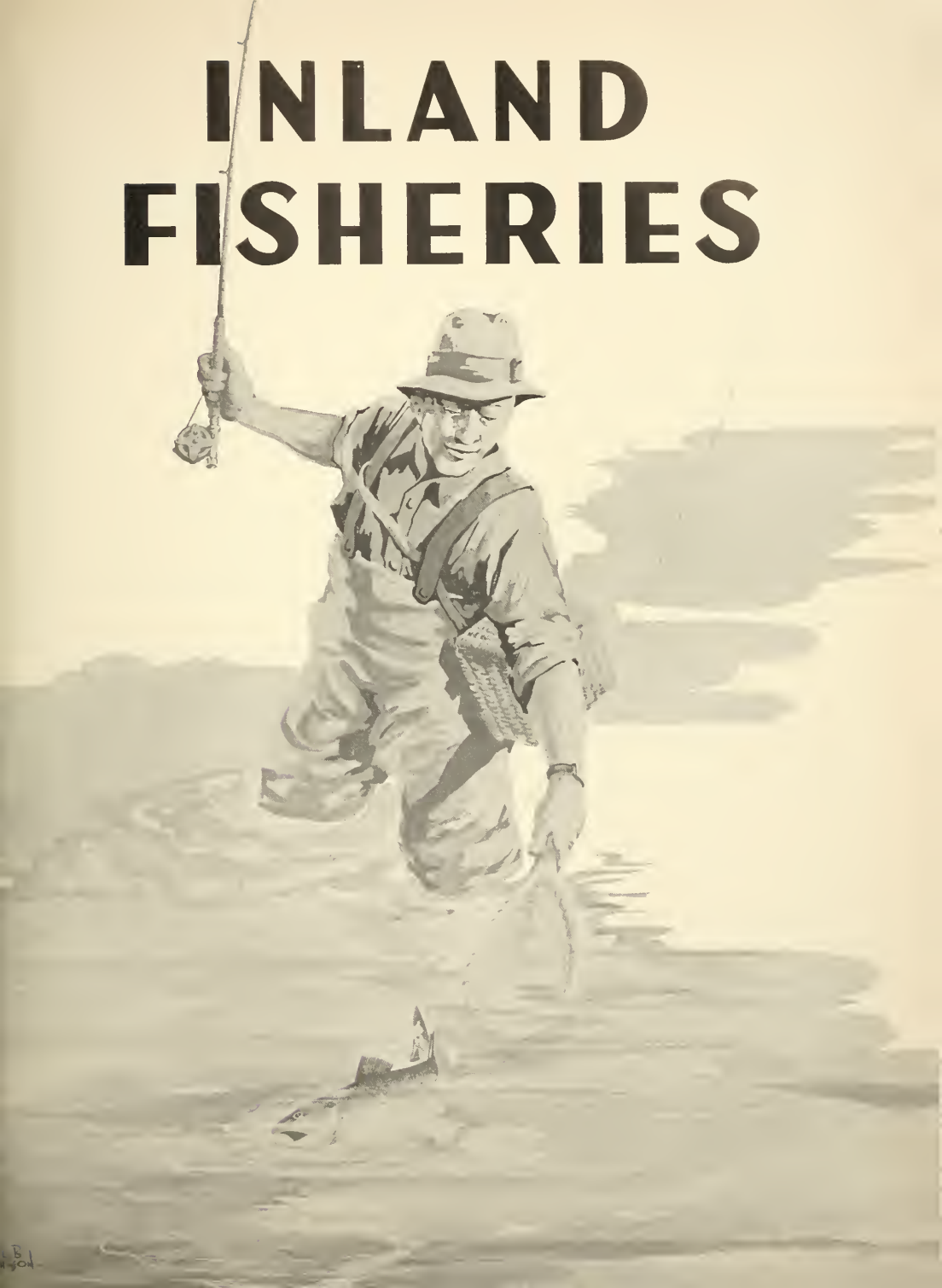
## OTHER ACTIVITIES

During the biennium more than $19,000 was deposited in the Fish and Game Preservation Fund as a result of sale of equipment used in illegally taking fish and game. Sales by sealed bid were held in the various regional offices.

A total of 643 items, including guns, tackle, nets, spears, and other sports and commercial gear, was auctioned for $19,206, with sales being held at all five regional headquarters in Redding, Sacramento, San Francisco, Fresno and Los Angeles. Most illegal items were sold at the Los Angeles office of the department.

Added investigative work by wardens resulted from 1953 legislative action relating to hunter casualties. These changes provided for permanent revocation of a hunter's license for killing or wounding a human being, and a five-year revocation in cases involving domestic animals. Wardens investigated these cases and made reports transmitted to county district attorneys for action.

# INLAND FISHERIES



*Emphasis placed on sound management of existing fisheries.*

*Greatest expansion of trout hatcheries in history recorded.*

*Stream and lake improvement program highlighted as management tool.*

*New forage fish introduced into California waters to improve warmwater fishing.*

*Branch surveys 142 streams and 321 lakes to obtain data for fisheries management.*

## INLAND FISHERIES

Intensified angling pressure and increased water utilization continued to aggravate the already difficult task of maintaining satisfactory angling for California's growing population. The State's great natural fisheries of trout, steelhead and salmon, striped bass, and warmwater species are now and always will be the backbone of angling recreation.

Increased emphasis is being placed on their sound management, for it is important, above all else, to maintain them in the best possible condition. The cost of doing so is negligible compared with the cost of improving angling by stocking or stream improvement.

New dams and water diversions for power and irrigation continued to create serious fisheries problems. Every effort was made to obtain adequate protection for the fisheries they threaten as well as to take full advantage of any new fisheries possibilities they present.

Programs which offer the greatest promise for improving angling at a reasonable cost were expanded as rapidly as available funds permitted. Financial assistance from the Wildlife Conservation Board and the federal aid to fisheries program permitted a gradual, orderly expansion of these activities. Special emphasis was placed during the biennium on lake and stream improvement of several types; and major expansion of the catchable trout program, coupled with an analysis of its role in the California angling picture.

Increased emphasis was placed on warmwater fish. A series of carefully selected new species was introduced into various waters as part of a broad program to evaluate the possibilities they offered for improving angling.

In the description of the departmental program during the biennium which follows, a broad separation has been made between management and investigational activities.

### FISHERIES MANAGEMENT

In general, fisheries management includes all of the great variety of operational projects aimed at improving angling, based on facts obtained through research. Thus, it encompasses such diverse activities as fish stocking and rescue, barrier removal, construction of flow maintenance dams, installation of stream improvement devices, construction and maintenance of screens and ladders, rough fish control, and enforcement of regulations.

Effectiveness of the department's fisheries management activities was greatly increased by the decentralization resulting from reorganization, and the attendant strengthening of local supervision.

This management work is now a regional function, although the various regional activities are coordinated into broad state-wide programs.

### FISH PRODUCTION AND PLANTING

The major fisheries management activity, in terms of annual expenditures, is the production and planting of hatchery-reared trout.

The period covered in this report has seen the greatest expansion of trout hatcheries ever undertaken in California, and perhaps by any state in the Nation.

As a result of $4,300,000 made available for capital investment purposes by the Wildlife Conservation Board over the past five-year period, California's huge fish hatchery expansion program, which got under way during the previous biennium but was slowed down due to wartime restrictions, got into high gear during the latter part of 1952. Two new hatcheries were completed, two existing hatcheries were improved and expanded, construction of one additional hatchery was started, and plans completed for two additional new hatcheries. The two new units are Darrah Springs Hatchery, located near the Shasta-Tehama county line, about 27 miles east of Red Bluff, and the Moccasin Creek Hatchery at Moccasin, Tuolumne County.

Darrah Springs Hatchery, representing an investment of approximately $765,000, is the largest trout hatchery in California. Approximately 30 cubic feet of water per second, coming from springs at a temperature of 56 degrees, supplies 60 earth-fill, raceway-type ponds, 124 standard hatchery troughs, and 32 nursery tanks. Exceptional growth is obtained at this installation. Fish growing at the rate of one inch per month permit production of two crops of catchable fish each year.

Other facilities include a large food preparation building with refrigerated storage for approximately 200,000 pounds of fish food, a garage and shop building for truck and equipment storage and routine maintenance work, and 12 houses for hatchery personnel. The hatchery has a potential output of 2,000,000 catchable trout weighing 300,000 pounds annually.

Being strategically located in the very hub of a large fish distribution area, the results from catchable trout produced at this new hatchery will be felt over a wide area in Northern California.

#### Lease Arrangement

The new Moccasin Creek Hatchery, located immediately below the Moccasin Creek powerhouse afterbay in Tuolumne County, was completed just at the close of the 1953-54 Fiscal Year. The hatchery is located on property owned by the City of San Francisco, and is

*Moccasin Creek Hatchery, completed during the biennium.*

occupied on a long-term lease arrangement. Water for operating the unit is obtained by gravity flow from the powerhouse afterbay.

The initial installation includes 24 rearing ponds, a hatchery building with 120 troughs, food preparation and refrigerated storage building, and six residences. While the hatchery was completed during the period covered by this report, it was turned over to the department too late to begin operation during the biennium. Its strategic location near important trout waters remote from other hatcheries makes it a particularly valuable installation.

Important expansion and improvements were made at several installations, particularly Crystal Lake Hatchery near Cassel, Shasta County; and Mojave River Hatchery near Victorville, San Bernardino County. Construction of the Crystal Lake Hatchery was actually begun in 1947, when 24 ponds with necessary water supply facilities were installed. Soon after the ponds were placed in operation, serious disease problems developed and it became evident that water from Crystal Lake itself was not suitable for fish cultural purposes. Pipelines were accordingly extended to bring in water from nearby Rock Creek, which proved satisfactory.

New facilities at this installation represent an investment of $208,000, and include a garage and shop building, food preparation and refrigerated storage building, and four employee residences. The hatchery, located adjacent to the north boundary of the Lassen Volcanic National Park area, has been an operating unit since 1948. During the 1953-54 Fiscal Year it produced 341,832 trout weighing 64,515 pounds. These were distributed mainly in Shasta, Modoc, Lassen, and Plumas Counties.

### Ponds Doubled

Production facilities at the Mojave River Hatchery near Victorville, San Bernardino County, were doubled by increasing the number of ponds from 20 to 40, and drilling two new wells to supply water. A large aerating tower for dissipating harmful gases from the water was installed, and a new food preparation and storage building and three new residences were built.

This hatchery, which first became an experimental unit in 1947, received its entire water supply from four wells on the property. Each year its production has increased. During the past fiscal year 672,920 trout weighing 80,220 pounds were produced and distributed in the Southern California area. The expansion recently completed at this installation makes it the largest hatchery in Southern California.

Other minor improvements to hatchery installations financed with Wildlife Conservation Board funds were made at Mt. Shasta, Black Rock Rearing Ponds, Fillmore and Hot Creek.

Construction of the San Joaquin Hatchery, below Friant Dam at Millerton Lake, in Fresno County, is well under way and this new unit will be finished early in the 1954-56 biennium.

Plans were completed for the new Cedar Creek Experiment Station in Mendocino County and bids were called for this project. Initially, work at this installation will center around stocking experiments with aged steelhead trout.

As part of the salmon and steelhead restoration program to compensate for loss of salmon and steelhead runs in the American River resulting from construction of the Folsom and Nimbus Dams, plans were worked out in collaboration with the U. S. Bureau of Reclamation and the U. S. Fish and Wildlife Service for a large salmon and steelhead hatchery to be constructed by the Bureau of Reclamation and operated by the State, with the Reclamation Bureau reimbursing the State for operating costs.

The over-all hatchery expansion program provided that as new, efficient hatchery facilities were completed and placed in operation, the older, outmoded hatcheries would be abandoned. Accordingly, the Brookdale, Lake Almanor, Mt. Tallac, and Feather River Hatcheries were permanently closed during the biennium. Upon completion of the San Joaquin Hatchery, the old Kings River and Madera Hatcheries also will be abandoned.

### Increased Capacity

The hatchery expansion program has increased catchable fish production from 539,554 pounds during the 1951-52 Fiscal Year to 796,384 pounds in 1953-54, or a total of 1,631,688 pounds during the biennium. This created serious distributional problems. Fortunately, in 1953 it was discovered that the addition of

one-half grain of sodium amytal per gallon of water would more than double the carrying capacity of fish-planting tanks.

Use of this drug, which decreases activity and hence oxygen requirement, coupled with addition of three 150-gallon, six 500-gallon, and three 1,500-gallon tank trucks and operation of six fish-planting bases enable the planting crews to keep up with increased production.

The new 1,500-gallon units are invaluable for long-range highway transportation of large quantities of fish from hatcheries to seasonal planting bases. Throughout the State, 40 smaller 150-gallon fish-planting tanks mounted on pickup-type trucks are used for final distribution of the fish from both hatcheries and planting bases to their final destination. The 500-gallon tanks are used for lake stocking, large streams, and smaller fish transfers.

The stepped-up catchable trout program has also aggravated the problem of providing sufficient inexpensive fish food for the State's hatcheries. This challenge has been met by improving methods of feeding fish in ponds and by using new products, which were formerly wasted. Development of a method for processing fish frames provided a large source of good, inexpensive food. These frames include the remains of rock cod and petrale sole after the fillets have been removed.

This material is ground at the source to the desired size and placed in moisture-proof paper bags, then quick frozen. The product is fed to pond fish by stripping off the paper bag and placing the block of food in the pond. This food has sufficient buoyancy to float, and is held in place in the pond by an anchored frame made of two-inch by four-inch material.

Fish nibble at the food from the bottom and sides and eat as it thaws. This eliminates a considerable loss of food in ponds, since small particles do not flake away and settle to the bottom.

Usually, two or three feeding frames are used in each 100-foot pond. This method is highly satisfactory and does not result in any greater variation in size of the fish than when food is scattered by hand.

### Fingerling Production

Fingerling production has continued at about the level of the previous biennium, with a total of 26,964,000 planted during the two-year period. These fish were used to stock high mountain lakes in remote areas, and other waters where conditions were especially favorable for fingerling survival.

A major change in production during the biennium was the resumption of golden trout operations in 1952-1953.

Golden trout had not been hatched by the State since 1941. The fresh start was a direct result of the Fish and Game Commission's "Golden Trout Policy" adopted on October 16, 1952.

Egg-taking operations started again at the Cottonwood Lakes, and a start was made toward procuring a broodstock from Golden Trout Creek. In former days most of the fish were planted as fry. Under the new policy, the department started its attempts to raise goldens to fingerling size. Plants under this policy are to be confined to barren waters and to a number of specially designated lakes in a limited program of maintenance stocking. During the 1953-54 period, 201,295 golden trout were planted in lakes of the southern Sierra Nevada.

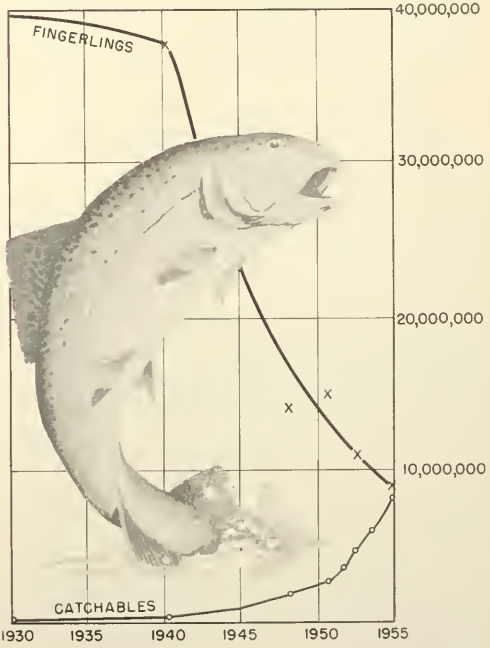
From the standpoint of numbers, fingerlings planted during the biennium represented 73 percent of the total plant. By weight catchables made up 94 percent of the total.

From July 1, 1952, to June 30, 1954, the department planted a total of 26,964,700 trout and salmon, with a total weight of 1,631,678 pounds.

For the first time, an adequate cost analysis study was made for the entire hatchery and planting program, but results were not available at the close of the biennium.

A complete summation of fish distribution will be found in Table 10, Appendix.

TROUT PLANTINGS



### Fish Rescue

The effect of large multiple purpose dams on principal river systems is reflected in the department's fish rescue operations. Each year, more runoff water is brought under control. The overflow areas in the central valley are reduced, and less fish rescue work becomes necessary.

Warmwater fish rescue operations centered mainly in the Sacramento-San Joaquin Valley areas, while salmon and steelhead salvage work was carried on mainly in the north coast sections of the State. The latter takes place during periods of low water on coastal streams, when steelhead and salmon fingerlings are trapped in pools or lagoons. Nearly 1,500,000 fingerlings were saved and transplanted during the past two years.

A tabulation of the fish rescued is found in Tables 16 and 17, Appendix.

## STREAM AND LAKE IMPROVEMENT

Restoration and improvement of environment is increasing rapidly in importance as a fish management tool in California. There is growing emphasis on stream and lake improvement of many sorts, aimed at producing more fish as well as putting more of those already present into the creel. Increased emphasis also is being given to improvement of warmwater lakes by introducing new species of game or forage fish.

Major objectives of the department's stream and lake improvement program are:

1. To remove barriers to the migration of fishes, so that the adults may reach suitable spawning areas and the young may pass downstream.
2. To increase stream flows to aid fish migration, and to keep streams from drying up.
3. To improve the habitat in existing lakes and streams and to create new waters where it is economically feasible to do so.
4. To increase and improve spawning grounds.
5. To control undesirable species by chemical treatment of lakes and streams.
6. To improve forage conditions for sport fishes.
7. To provide increased utilization of the resource when it is safe to do so.

During the biennium the scope of this work was carried out by the five regions and was materially increased by financial assistance from Wildlife Conservation Board funds, Federal Aid Project F-4-D, and county fine moneys.

### Barrier Removal

Major work on north coast stream clearance during the biennium was accomplished through the use of Federal Aid in Fish Restoration funds (D-J Project F-4-D). Slides and waterfalls forming barriers were removed or altered in eleven streams from Monterey County northward, allowing easier passage of steelhead and salmon into 130 miles of stream.

Removal of a barrier on Mill Creek, Tehama County, made some 35 miles of stream more readily accessible to salmon and steelhead.

Log jams were removed from nine streams utilized by anadromous fish. The majority of these were in the north-coastal area where log jams are generally conceived as a by-product of logging activities. Benefits derived by their removal are often transitory in nature, being reaggravated by the next period of high or abnormally high waters.

With the advent of enlightened watershed management, the rate of development of log jams should decrease. All log jams removed by the department were those where the determination of the party responsible could not be ascertained. Most of this work was accomplished by Federal Aid crews.

Minor log and debris removal was also done on various lakes to insure access of fish to and from spawning tributaries.

An abandoned mining dam was removed on Cecil Creek, Siskiyou County, to allow passage of anadromous fish. Beaver dams on several streams were removed to prevent flooding and to allow spawning migrations of trout to pass. In most instances the game manager live-trapped the beavers and transplanted them to more suitable areas.

### Stream Flow Maintenance Dams

The department's stream flow maintenance dam construction program designed to improve natural trout habitat, has been continued under the auspices of

*Log raft used in chemical treatment of Tamarack Lake, Mono County. Materials at hand often are used in back country activities.*

the Wildlife Conservation Board, and a complete report of these activities is shown under that heading. Nine such dams were completed during the biennium, three were started but not completed, and one previously constructed dam was raised to increase the water storage.

### Other Flow Maintenance

Irrigation waters were channelized into Pine Creek, Lassen County, facilitating downstream migration of trout into Eagle Lake.

Gravel wing dams were constructed with bulldozers on the lower Eel River, Humboldt County, to deepen the channel and minimize losses of anadromous fish attempting to enter the river. This was accomplished with Federal Aid funds.

### Lake Construction and Improvement

Work was begun on Indian Basin Lake, Fresno County, where a trout lake of about nine acres in size will be constructed with Wildlife Conservation Board funds. This work is being done by a contract with the U. S. Forest Service.

Preliminary surveys have been made at several other sites to determine feasibility of constructing other trout and warmwater lakes.

At Doane Lake in San Diego County, the marginal area was deepened, an old dam removed, and vegetation controlled under a Wildlife Conservation Board project.

The bed of Dry Lake, San Bernardino County, was treated with bentonite to eliminate water loss through seepage.

A diversion ditch was opened from Little Kern Lake Creek, Tulare County, to provide a constant flow of water into Little Kern Lake. A more permanent headworks structure is planned for the next biennium.

In accordance with instructions from the Legislature, the department made a survey of the snags and logs in Lake Almanor, Plumas County, to determine the feasibility of removing them. The survey indicated that their removal would cost about $1.600,000.

### Stream Improvement Devices

Spearheaded by a Wildlife Conservation Board project, the department began a major stream improvement program in southern California. Emphasis was placed on pool building devices to provide sufficient water and cover for planting of catchable trout. The Santa Ana River received the greatest number of structures with installation of 252 devices.

Log and rock deflectors; log, piled rock, and rock masonry dams have been installed on 13 different streams. The type of structure used was determined by the nature of the stream and the materials at hand, although all are in experimental stages of design, location and feasibility.

*Typical rock deflectors constructed for flow maintenance and creation of natural pools for trout habitat.*

Various counties assisted through county fine monies. Many sportsmen and sportsmen's groups in the area gave generously of their time and effort. As a result of the combined efforts, more than 650 such devices were installed. Unfortunately, flash floods produced by localized cloudbursts removed 92 in one drainage.

### Aquatic Plant Control

Continuing its policy of improving lakes for fishing wherever possible, the department investigated uses of new weedicides for control of aquatic plants.

Pilot investigations of weed control were continued at Twin Laks, Mammoth, Mono County, with sodium arsenite, and the department did further work at Doane Lake, San Diego County, and Crystal Lake, Los Angeles County. Experimental work with CMU was carried out at Lost Lake, Fresno County, and with Borascu at the Moon Lake, San Bernardino County.

### Fish Population Control

Chemical treatment continued to be the most useful tool in control of undesirable fishes and reduction of stunted populations. Rotenone-bearing powder was the primary chemical used. Methods of application varied from the use of a log raft in a back-country lake to the dissemination of an emulsifiable rotenone compound by aircraft. Aerial observation also proved useful in the Grouse Ridge area lakes in Nevada County so that accurate determination of lake areas could be made. Such information is needed to determine the proper amount of chemical needed.

California's own "cubebeater," a self-propelled mixing device developed by the department was used effectively on one of the big jobs at Lake Merced,

*Electro-fishing, which harmlessly stuns fish, can be used to segregate species of fishes, to determine populations, and for trapping fishes for egg taking.*

San Francisco County. (This is the same device which Oregon made use of in its treatment of Diamond Lake late in 1954.)

The department's rough fish control activities were highlighted by the eradication of rough fish in Bass Lake, Madera County, and in 10 miles of its tributary streams. This 1,165-acre reservoir was treated when the Pacific Gas and Electric Company drew down the lake to repair the outlet valves. Many of the game fish were rescued and held for restocking the lake after chemical treatment. The weight of carp killed greatly exceeded the weight of game fish.

Twenty-four other lakes and ponds were also treated with rotenone to eliminate rough fish. Most of these waters have been restocked with game fish to provide improved fishing. Forage species have also been introduced in waters suitable for them. See Table 20, Appendix, for a tabulation of results.

### Chemical Treatment

Large-scale chemical treatment of streams was attempted for the first time during the biennium. A program was initiated in the Russian River drainage to improve conditions for steelhead trout by eliminating rough fish in several tributaries. Here a checkup showed that no more than 5 percent of the resident fish were game fish. About 87 miles of tributaries were treated in Dry and Maacama Creeks, in Sonoma County. In most instances barriers were built or natural barriers were utilized to prevent re-entry of rough fish.

Santa Ysabel River and its tributaries, San Diego County, were also treated with rotenone to remove undesirable fish before inundation by a contemplated water project.

Numerous sportsmen's groups have assisted materially in the department's rough fish control program by donating many hours of work. Various counties also assisted by making county fine money available for purchase of rotenone.

In 1953 electrofishing was used for the first time in California to segregate species of fish in population control. It was used in Pine Creek, Lassen County, to separate the Eagle Lake rainbow trout from its competitor, the eastern brook trout.

An experimental gill netting program was conducted at Convict Lake in Mono County in 1953 to remove large predatory brown trout. These fish consumed many of the catchable rainbows which are stocked annually, but are themselves almost invulnerable to capture by angling. A total of 124 browns weighing 368 pounds was removed during the operation. The largest weighed over 20 pounds! Creel census records from 1954 will be compared with past catch records on this lake to determine the effect of this experiment on survival of rainbow trout. Whether or not such work is justifiable in view of the time and special equipment required, still is uncertain.

### Carp Permits Issued

Carp seining permits have been issued wherever practicable to reduce competition with game fishes for living space.

During the biennium more than 651 applications for the stocking of private ponds were processed, 282 ponds were visited, and about 500 ponds were stocked with fish by the owners. See Table 21, Appendix.

It has been the policy of the Department of Fish and Game to supply an initial stock of fish of warmwater fishes to private ponds too small to support public fishing and which meet certain other requirements. Trout for such ponds must be purchased from a licensed domestic fish breeder.

Largemouth black bass and bluegill have been the usual species stocked. The department has been particularly anxious to find species of fish which will reproduce in the colder waters of coastal and North-

ern California ponds. A few experimental plants of yellow perch and Sacramento perch were made with this in mind.

## FISH INTRODUCTIONS

The Department of Fish and Game has continued its work of introducing species whose establishment in fresh waters may be beneficial.

In 1953 the fathead minnow was imported from New Mexico and it spawned successfully in hatchery ponds during the same year. Experimental planting has been carried out in several lakes in the hope that it will be a useful forage fish..

In the spring of 1954 another forage minnow, the plains red shiner, was brought to northern California and is now being propagated at Cehtral Valleys Hatchery. It spawned successfully there in June, 1954.

Outstanding introductions of the biennium consisted of the importation of the threadfin shad and the redeye black bass, also known as the Coosa bass, into California. The threadfin is being introduced in the hope that it will provide hitherto lacking forage for black bass and other game fish in large reservoirs, while the redeye is expected to provide fishing in lowland foothill streams, too warm for trout and too small for other kinds of black bass.

Following extensive negotiations and experiments with transportation equipment, the shad were seined from the Tennessee River in Tennessee and flown to California. Despite adverse weather conditions, 357 of the delicate shad survived and were introduced into brood ponds in San Diego County in November, 1953. In May of 1954 they spawned prolifically. The first experimental plant from this spawning was made in San Vicente Reservoir, San Diego County, in June, 1954.

### Redeye Bass Imported

Forty adult redeye bass were brought out from their native waters in Tennessee by the department's airplane in 1953 and all but one survived the trip. These fish were settled in a pond at Central Valleys Hatchery, where some of them spawned in the spring of 1954.

Additional plants and checkups were made of several other non-native species which have been resident in the State for some time. Since 1950 there has been a concerted effort to establish the golden shiner as a forage fish in reservoirs throughout central and northern California. It has been found to have spawned successfully in some of them, and evaluation of its effect now is being carried out.

Smallmouth bass were first recorded in the Colorado River below Parker Dam in 1952 from a plant made three years before, and a booster plant was made in 1953. The fish were taken by air from Central Valleys Hatchery to Blythe.

White crappie which were brought from San Diego County lakes to Coyote Reservoir, Santa Clara County, and East Park Reservoir, Colusa County, in 1950, were found to be producing excellent fishing in 1954.

### Good Kokanee Spawns

Spawning runs of Kokanee salmon, first introduced into California in 1941, were observed in tributaries of Lake Tahoe, Shasta Lake, and Lake Almanor. The 1952 spawning runs in Tahoe were particularly gratifying. They represented the first adults from the first major planting of fingerlings in 1949. Runs in the tributaries of Shasta Lake were exceptional, since they occurred during the summer instead of during the winter as expected.

In addition to the new introductions and checkups on older ones, the department tried out several species of native fishes in waters where they were not resident.

Two native species of freshwater smelt found in the lower Sacramento-San Joaquin Rivers showed promise as a forage fish for cooler reservoirs. Early in 1954, these fish, the Sacramento smelt and freshwater smelt, were introduced into three Central California Reservoirs.

The native California killifish was introduced into Lake Elsinore, Riverside County, in April, 1954, in an attempt to establish a forage fish in this alkaline and unstable lake.

In an attempt to build up a run of steelhead in the Mokelumne River, steelhead from coastal streams were planted there in 1953.

*The threadfin shad, a faroge fish being intraduced into warmwater reservoirs for foroge far game fish. It was brought from Tennessee.*

*How many did they catch? Partial answers come from post card surveys and creel checks.*

## INVESTIGATIONS

There is a serious need for more information about California's inland fisheries. Only wise regulations based on facts, not opinions, are going to protect them from skyrocketing angling pressures and the other effects of the state's growth, such as pollution and increasing water use.

Knowledge of practical ways to increase angling by improvement of natural habitats also is in short supply. It offers the only hope for meeting ever-increasing demands for good angling recreation.

Without exception, the department's inland fisheries investigations are aimed at learning how to improve and regulate important sport fisheries. They are therefore among the branch's most practical, down-to-earth activities.

Generally speaking, they fall into two groups: routine surveys or inventories of transient or local importance; and basic or long-range research projects whose results have a more far-reaching use.

Under the reorganization plan, data for the first type usually is gathered by regional personnel while the more basic work is performed by the staff. As the biennium progressed, more and more of the long-range studies were funnelled into the Federal Aid program.

### State-wide Angling Surveys

Intensive analyses of state-wide sport catch and angling trends have been made periodically since 1936 on the basis of postal-card surveys. The number of sports anglers in California continues to skyrocket, and in 1953 license sales established an all-time high to lead the nation. The 1,187,357 licenses sold represented an 8 percent increase over 1952 and a 17 percent increase over 1951 when the last state-wide angling survey was made.

On the basis of answers received from a random sample of license holders, California anglers in 1953 had the greatest year in history. The increase in anglers was reflected in almost all phases of sport fishing. See Table 22, Appendix.

Some 530,000 anglers caught trout, a gain of 24 percent over the 1951 survey. Successful salmon anglers increased 40 percent; black bass, 50 percent; striped bass, 15 percent; catfish, 32 percent; sunfish, 30 percent; and crappie, 76 percent; as compared to the 1951 survey. These estimates do not include those anglers who fished unsuccessfully.

The 1953 survey catch-estimates were up for all species, surpassing previous records for all freshwater and anadromous fish, except striped bass and catfish. The black bass catch was 84 percent greater than 1951; catfish, 59 percent; crappie, 50 percent; and sunfish, 29 percent greater. Major increases were in the warmwater catch, and reflect the additional angling pressure and improved water conditions.

### Ocean Fishing Second

The survey indicates ocean fishing was second to trout in popularity. An estimated 340,000 people fished in the ocean or gathered shellfish.

Trout anglers reported they averaged 42 fish last year for a record total of 22½ million, an increase of 20 percent over the 1951 survey estimate of 18½ million. Salmon anglers reported a catch of 640,000 fish for an all-time high as this sport continues a deserving increase in popularity. For the first time information was gathered separately on steelhead trout. An estimated 310,000 were caught by 56,000 anglers.

Questionnaires further showed that 1,590,000 striped bass were taken by 166,000 anglers. The striper catch has remained fairly constant in recent years but the number of anglers catching these fish has increased 15 percent in the last two years. All warmwater species showed considerable increases as compared to the 1951 survey. Most notable was the reported catfish take of 7,470,000 and the black bass catch of 2,300,000.

California anglers spent an estimated 15½ million days fishing last year, almost a third of which were for trout. Black bass and other warmwater fish accounted for 3,700,000 days or 24 percent and striped bass anglers 2,000,000 days or 13 percent. Ocean fishing enthusiasts spent 3¾ million days angling or 22 percent of the total days reported by respondents. The average angler spent about 14 days in pursuit of his sport.

## STREAM AND LAKE SURVEYS

Fisheries management personnel spent considerable time gathering and interpreting information about the various waters of the State and their fisheries resources as a basis for management plans and regulations. Subsequently, they followed developments in the various

| *Station* | *Stream* | *County* | *River system* |
|---|---|---|---|
| Klamathon Racks | Klamath River | Siskiyou | Klamath River |
| Shasta Racks | Shasta River | Siskiyou | Klamath River |
| Sweasey Dam | Mad River | Humboldt | Mad River |
| Benbow Dam | Eel River, South Fork | Humboldt | Eel River |

The fish count at these stations during the biennium:

| *Year* | *South Fork of the Eel River (Benbow Dam)* | | | *Mad River (Sweasey Dam)* | | | *Klamath River (Klamathon Racks)* | *Shasta River (Shasta Racks)* |
|---|---|---|---|---|---|---|---|---|
| | King salmon | Silver salmon | Steelhead | King salmon | Silver salmon | Steelhead | King salmon | King salmon |
| 1952-53 | 7,256 | 3,711 | 19,448 | 401 | 72 | 5,568 | 6,591 | 1,666 |
| 1953-54 | 7,948 | 3,052 | 15,425 | 853 | 92 | 3,959 | 6,267 | 1,605 |

lakes and streams closely enough to know if the desired results were being achieved, or, if not, to change the management programs.

These routine surveys were carried on primarily under regional supervision.

Initial surveys were made of 142 streams and 261 lakes. (See Table 23.) Rechecks were made of many other waters.

### Fish Counts and Inventories

For some years the Inland Fisheries Branch has carried out counts of spawning runs of steelhead and salmon at various stations. Such counts provide a basis for management programs and for recommendations in connection with proposed large dams. The following stations were operated during the past biennium:

### Population Studies

A knowledge of the sizes of fish populations has become more and more essential in recent years for a basic understanding of both theoretical and practical fishery problems and their solutions. Particularly desirable is comparative information on the status of fish populations for both fished and unfished waters.

Warmwater impoundments in the Central Valley of California might be expected to yield large numbers of game fish. Yet data has been presented which indicates that the Central Valley with its many impoundments contributes rather small catches of warmwater fish compared with the Sacramento-San Joaquin Delta or the San Diego region.

While it is true the impounded waters of the Central Valley lie near the heavily fished Sierra and Delta areas, which are presently preferred by many fishermen, there is little doubt that they would be much more popular if they provided better fishing. Learning why they are so unproductive is the first step toward discovering how to improve them.

The problem is largely one of population size. Are the reservoirs productive? Do they have large fish populations? Is there competition between desirable and trash species? Is there a sufficient forage population to support desirable predatory species? A knowledge of the numbers of the various fishes present will obviously go a long way toward providing answers to questions like these.

Determination of fish population estimates is by no means a simple task. However, several well established methods are available. Of these, the mark-and-recapture technique presently seems to offer the greatest possibilities. Following methods developed in 1951 and 1952, the technique has been extended to several California reservoirs such as Dallas-Warner (Modesto) in Stanislaus County.

Partial population-composition studies by the use of rotenone have also been carried out throughout the State.

One of the most noteworthy developments during the biennium was the increased use of electro-fishing to make population inventories. Shockers which stun the fish temporarily were used in the San Lorenzo River, Santa Cruz County, to evaluate the steelhead populations. They were used in the Pit River in connection with cooperative studies with the Pacific Gas and Electric Company on the effect of disminished flows on the game fish population. Studies on the survival of catchable trout and the effects of stream improvement were started in Southern California towards the close of the biennium.

### Creel Censuses

In addition to such long range inventories and population studies, the department conducted creel censuses on 118 lakes and streams.

A few of these, such as Castle Lake, Siskiyou County, and Rush Creek, Mono County, were special test waters where the results of study can be applied to like waters. However, the majority of the counts were aimed at obtaining information which will be of direct application to the censused waters.

The principal creel censuses carried out during the biennium are tabulated in Table 10, Appendix.

In addition to these, spot censuses were made of many individual waters.

### Inland Trout Studies

With the advent of reorganization, most of the previous trout investigations were shifted to a new Dingell-Johnson project, F-8-R, "Trout Management Study." By the start of the 1954 fishing season, this project was well under way with six principal jobs or subprojects:

*(1) Castle Lake, Siskiyou County*

The rainbow trout phase of the Castle Lake investigation was begun in 1952, and since then only this species has been planted. Brook trout continue to maintain themselves without further stocking. Previously brook trout had been planted, and it was found that when they alone were present the return to the angler of planted fingerlings was 35 percent. Return of catchable brooks was 43 percent. Prior to chemical treatment of the lake in 1946, the brook trout were preyed upon by browns and lake trout (mackinaw) and never attained the age of more then three years. In addition, the natural reproduction of the brooks is surprisingly successful.

Prior to chemical treatment, the catch of naturally spawned brooks was insignificant, while now the wild fish dominate the catch. The carryover of fall-spawning rainbow catchables is reasonably good. A comparison was made between rainbow fingerlings planted by air and by truck. To date the angler catch of truck-planted fish from Castle Lake is twice that of the plane-planted ones.

*(2) Rush Creek, Mono County*

Prior to 1953 only rainbow had been planted in this test stream. Most of these were fall-spawning catchables and the plant was characterized by a very high return to the angler almost immediately after planting. There was almost no carryover to the next year and no natural propagation.

Beginning in 1953, only brown trout have been planted. These were catchables, and it was found that only 20 percent were caught in the first season. However, in the case of the browns, there is a very good carryover and excellent natural reproduction. In 1954 the wild browns dominated the catch.

*(3) Feather River*

Proposed hydroelectric developments by the Pacific Gas and Electric Company will divert most of the water from the Caribou-Gansner Bar section of the Feather River by 1956. By making a complete creel census of this river section for three years prior to the diversion and for about five years afterward, it is expected that effects of such a diversion on the fishery can be detected. This is one of the richest sections of rainbow stream in California and is completely accessible by road. It contains an excellent native rainbow population and the catch is high both in numbers and pounds.

*(4) Lakes Basin Recreation Area, Sierra and Plumas Counties*

Here, a partial creel census is being made to test a large number of management practices. Approximately 18 natural trout lakes can be checked by two attendants, but it is not yet known how many of these will be needed for experiments. Three lakes have already been stocked with marked trout. Tests will be made in the form of comparisons, and no attempt will be made to determine total catches.

Adequate statistical samples will indicate which of two or more contrasting methods is best. In one lake four strains of rainbow were planted in 1953 to see which is best for lakes of this type. In a second lake both catchable and fingerling browns are being planted to see which is better. In a third lake brook fingerlings are being planted by air and by truck to see which is better.

*(5) State-wide Brown Trout Project*

In addition to the Rush Creek project, information on that somewhat controversial species, the brown trout, is being gathered throughout the State. Part of the program calls for population studies based on electro-fishing or shocking. These will show the success of various methods of brown trout management and will indicate which types of streams are suitable for browns and which are not. Test waters are scattered throughout the State with both staff and regional personnel participating in the work.

*Checking station for Rush Creek Test Stream in Mono County. Tests determine relative merits of brown and rainbow trout for this stream.*

*(6) Brood Stock Selection*

The present strain of fall-spawning rainbow brood stock used in the California hatcheries is known to contain serious genetical weaknesses, particularly physical abnormalities. In order to rectify this condition a program of selection was begun in the fall of 1953 at the Mt. Shasta Hatchery. Some females were taken at random from the stock, and in each case the fish's eggs were divided into two parts; one part was fertilized by one male and the other part by another male. In turn each male was used to fertilize the eggs of two females. These lots of eggs, 69 in all, were held in separate trays until hatched.

Twenty-four of the best appearing lots were then retained for future brood stock. Data on fertility, viability, appearance, growth rate, etc., were kept on each lot.

Several special studies were carried on in several areas. Among these was a marked fish experiment on Brush Creek, Tulare County, which showed the usual small returns from stream-stocked rainbow fingerlings, a large return to the angler from catchables, and an even larger return from wild fish.

Studies were started in Region V in an attempt to discover what happens to "catchable" trout which are not caught by the angler. The same experiments are designed to show the effect of stream improvement on catchable trout fishing.

Trial plants of eastern brook fingerlings in Lake Merced, San Francisco County, had only small returns (although the fish grow well) by the close of the biennium.

### Back-country Fish Management Study

A total of 247 lakes, all lying in back-country areas of the Sierra Nevada and Siskiyou Mountain Ranges, were examined as part of a Dingell-Johnson project (F-3-R). Principal objectives were to evaluate current management practices, to work out rapid evaluation systems, and to put new or modified procedures into effect. Special efforts were made to obtain data on fish populations, spawning success, and angling use.

The project crew made repeated eight- to ten-day pack trips into back-country areas of the State, where initial surveys and rechecks were made of lakes and streams to develop sound management programs. The problem of lake overpopulations by brook trout was investigated, and routine equipment and methods were retested. Results of work were observed, and several chemical treatment jobs were undertaken.

Findings were discussed with management personnel, and assistance was given them in revising management policies. Planting allotments for back-country waters were submitted annually as a part of this survey program.

Experimental improvement work was carried on as a part of the field work wherever the crew was able to handle the job with the tools at hand. Most of the improvements consisted of consolidating stream channels, removing rock or log barriers to spawning areas, digging out sod blocks in lake inlets, and construction of rock dams.

*This pond, which will support small trout, was created by a rock dam on McGee Creek, Mono County.*

While this type of work was incidental to the regular field activities, considerable benefits to the lakes and streams were realized by these improvements. For example, the removal of a log barrier in one lake inlet, which required two hours' work, opened up 600 yards of spawning area to the lake rainbow population. It is very likely that no further planting will be needed to maintain a satisfactory population in this lake.

On two occasions rotenone was used to treat back-country lakes. One 10-acre lake was treated to remove eastern brook trout and rough fish preparatory to rehabilitation with golden trout.

In order to determine effects and desirability of improvement devices for possible use in mountainous areas, 41 improvement structures on the East Fork Kaweah River, Tulare County, were observed and evaluated. The structures were built in 1935 by the U. S. Forest Service. Twelve, all of log construction, remain in operation after 18 years. Those of earth, rock, masonry, plank and crib construction had been destroyed. An evaluation report was submitted for this study.

### Losses Investigated

Reports of the loss of Piute cutthroat trout from Cottonwood Creek, Mono County, due to floods were investigated. It was found that the trout were not only present, but they were well established as indicated by size range and abundance.

*An irrigation ditch is being tested to determine how many fish are being drawn through diversions and lost in fields.*

Several cases of winter kills were investigated in shallow high elevation waters. Losses were generally attributed to shallowness, abundant aquatic plants or lack of suitable inlets and outlets for circulation resulting in oxygen depletion.

Observations were made to determine the extent of losses of golden trout over a falls in the outlet of Alger Lakes, Mono County. Abundance of all sizes of golden in the lake without having been stocked for many years indicated that losses have not been excessive.

A study of the Shadow Creek, Madera County, drainage, containing eight lakes, were made to determine the feasibility of reclaiming the basin for golden trout. Due to a lack of spawning areas throughout the region as a whole, it was considered impractical. One isolated lake has been recommended for chemical treatment and rehabilitation of golden trout.

The project was terminated in June, 1954, and as an outgrowth of information gained a manual of back-country management covering all phases of the project activities is being prepared.

### Striped Bass

Scope of work on the striped bass fishery was temporarily reduced during the biennium as a result of personnel changes associated with reorganization and no new work was initiated. However, the system of catch records so vital to understanding the status of this important fishery was maintained, and surveys of spawning success were made each year. Much of the field data accumulated during the preceding five years of intensive work was analyzed and published. A new federal aid project was planned for initiation early in the next biennium, to pick up and continue the former long-range striped bass program.

Outstanding accomplishments in relation to this fishery during the biennium were made by other agencies in the field of screening large diversions. The department was associated with these activities in an advisory capacity.

### Practical Effects

The fish preservation project at the Contra Costa Stream Plant intake was successfully terminated by the Bechtel Corporation and the Pacific Gas and Electric Company. Information gained from this project was applied by Bechtel Corporation to design of the new Pittsburg Stream Plant. As a result, this installation should not present a serious hazard to the striped bass population.

Development of a new type of louver screen by the U. S. Fish and Wildlife Service staff assigned to the Tracy Pumping Plant also promises to resolve the extremely difficult screening problems which have arisen there.

### Sturgeon

It has become increasingly apparent to personnel working on the striped bass fishery in recent years that

sturgeon are once again abundant enough to support a fishery. These fish have been heavily protected since 1917. On the basis of departmental recommendations the Fish and Game Commission adopted an open season on sturgeon angling for 1954.

### Sacramento-San Joaquin River Salmon and Steelhead Study

This important federal aid project (F-7-R), begun during the biennium, is presently aimed toward two important objectives. The first is an evaluation of the anadromous fish losses occurring at the numerous water diversions in the Central Valley. Second is the derivation of a sound and practical management plan for the steelhead trout of the Sacramento River. Valuable data are also being gathered on king salmon, as a service to the Marine Fisheries Branch.

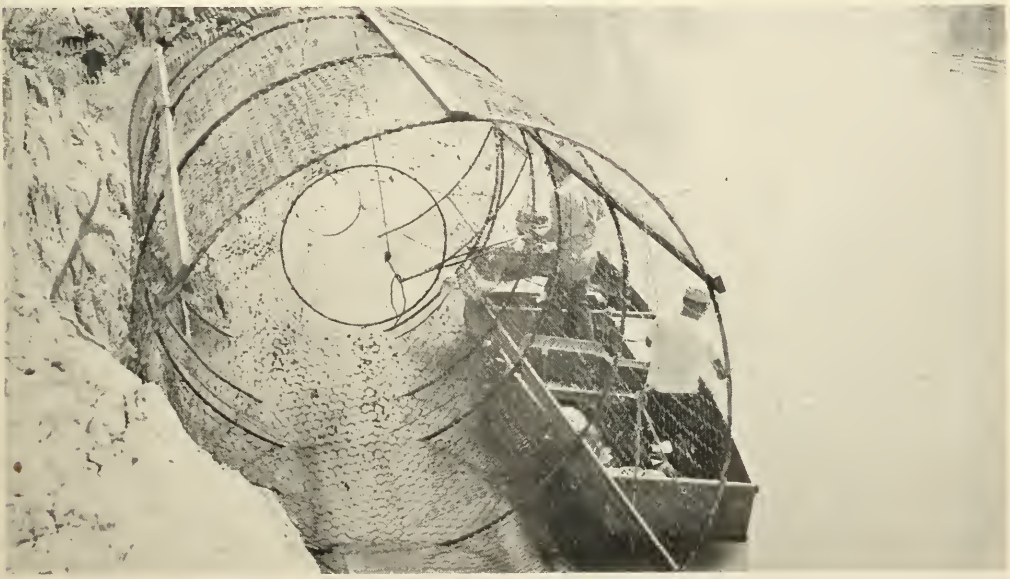
Work on the diversions has thus far been confined chiefly to the 246-mile section of the Sacramento River between the Cities of Redding and Sacramento, in which there are more than 300 points of diversion. All but one are pumping diversions, consisting of from 1 to 13 pumps and ranging in capacity from less than one to more than 2,300 cubic feet per second.

During the 1953 irrigating season initial surveys were made of each pump. Included was all the basic information on factors believed to influence fish losses, such as periods of operation, depth and position of intake, size and type of pump, etc. Notes were also made on whether or not the pump could be effectively tested for fish losses. Preliminary sampling was also done at several diversions.

With this phase of the work completed, several representative pumps are being tested with fyke nets through the 1954 irrigating season. Nets are placed in discharge outlets of the pumps. At the end of the season reasonable accurate estimates may be made of total numbers and species of fish lost through these pumps. Similar pumps may then be evaluated on the basis of these findings.

Results to date indicate that loss of seaward migrating king salmon fingerlings through diversions in the Sacramento-Redding area of the river is small, mainly because the majority of the young salmon migrate from this area during January, February, and March. Heavy irrigation does not normally begin until several weeks later. Observation of one 20-inch pump in Colusa County revealed that a loss of considerable magnitude can occur when there is early irrigation. At this pump over 1,200 young salmon were captured when the discharge was strained with fyke nets for 200 hours early in March. This is a much higher figure than the combined take of this and several other similar sized pumps during the entire month of May.

*A steelhead is returned to the Sacramento River after being tagged near Fremont Weir. Information on numbers and migrations of salmon and steelhead are obtained.*



### Damage Assessed

Most of the sampling is being done on pumps in the 12- to 24-inch class. They are by far the most numerous, and heretofore practically nothing has been done toward assessing their damage to the fish populations.

The apparent increase in the numbers of steelhead and steelhead fishermen on the upper Sacramento River since completion of Shasta Dam raises questions about the adequacy of present regulations such as bag limits, length of season, and closed waters. Another extremely important question requiring an answer is whether or not it is economically feasible to improve steelhead angling in the Sacramento River system by stocking yearling hatchery fish.

This project is working toward answering these questions by marking and planting hatchery reared steelhead, tagging adults on their upstream migration, creel censusing anglers, and checking upstream and downstream migrations on Mill Creek, one of the more important tributaries to the upper river.

The steelhead planting experiment is being carried out in cooperation with the United States Fish and Wildlife Service and Kamloops, Incorporated, a sportsmens' organization with headquarters at Redding. The fish are raised at the Coleman Fish Cultural Station where eggs are taken from wild fish, trapped ascending Battle Creek to spawn. A total of 215,438 marked yearling steelhead were planted during the biennium. The 63,590 fish released in 1953 were planted in Battle Creek, Mill Creek, and the Sacramento River at Ord and Princeton Ferries. Creel censuses indicated a large number of these fish were caught from Mill Creek and Battle Creek before migrating seaward. Therefore, the entire 1954 release of 151,848 fish was made in the Sacramento River at Princeton Ferry, where the fish are not nearly as vulnerable to angling pressure before migrating downstream.

*Tagging has provided much information on the Sacramento Delta catfish. Sportsmen have cooperated in the return of these tags.*

Success or failure of this program may be determined from the relative numbers of marked fish to wild adult steelhead found in the sport catch, in project operated river traps, at the Mill Creek Counting Station, and at fish collection facilities of the Coleman Fish Cultural Station.

### Fyke Nets Operated

During the 1953-54 steelhead and salmon runs, seven large fyke nets were operated in the Sacramento River near Knights Landing. These nets are used in cooperation with the Marine Fisheries Branch to capture adult fish for tagging and fin mark examination.

All data pertaining to salmon were turned over to the Marine Fisheries Branch, while this project has responsibility for the steelhead data. Between July 8, 1953, and June 15, 1954, a total of 2,114 steelhead was trapped and examined for marks. Of this number there were 59 marked fish from the 1953 spring plant. Petersen disk tags were placed on 1,472 steelhead over 14.5 inches long. Anglers thus far have returned 301 tags, showing a harvest of 20 percent.

The counting station on Mill Creek is at the fish ladder over Clough Dam, five miles upstream from the confluence of this stream with the Sacramento River. There have been 67 marked steelhead (9 percent) among the 715 that have been counted at this station.

During the steelhead fishing period between October 1953 and February 1954, 674 anglers were interviewed. Seventeen tagged fish (13 percent) were found in their total catch of 131 steelhead over 14.5.

These high proportions of tagged fish clearly show value of operating large fyke nets to determine the contribution being made by planting steelhead.

Considerable work on king salmon spawning area surveys and counts was performed during the biennium. This was done in cooperation with the Marine Fisheries Branch and the United States Fish and Wildlife Service.

### Warmwater Fish Studies

A new state-wide warmwater research program was organized early in 1953. One purpose of this program is to learn how to improve angling in the growing numbers of warmwater reservoirs and the many miles of California streams not now supporting a good sport fish population. Supervision of other studies such as those on catfish and striped bass also is a part of the program.

Much emphasis during the biennium has been placed on providing forage for largemouth black bass. Studies of our warmwater reservoirs have shown that low production is often not due to poor spawning, but rather to a lack of suitable forage for the little bass. When they reach a length of about three inches, small bass

assume a fish diet and there are not enough fish of the right size available in most California lakes.

Most native minnows, because of low productivity or natural and man-made environmental changes, have not been able to support the heavy predation required of a good forage fish, and attention has been directed to exotic species. The principal experimental introductions during the biennium have already been described under "Management."

Lack of success of forage minnows in some water supply reservoirs is being investigated. The role of copper sulfate, a widely used algicide, as a limiting factor is being studied with promising result.

Work also was begun to determine harvest rates of black bass. This knowledge is needed to increase understanding of black bass populations under California conditions, and for formulating sensible regulations. Tagging studies were begun at Clear Lake, Lake County, and on several Southern California reservoirs to discover how many of the bass are being caught each year.

Control of rough fish such as carp is the most important management technique now in use. A program to develop new methods of control was begun. Promising preliminary results were obtained with the use of poisoned bait for partial control of this species.

*Catfish food studies being carried out at Carmichael Laboratory. Contents of stomach are being examined.*

### Catfish Study

Federal Aid project F-2-R was initiated in January, 1952, when there were indications that the Sacramento-San Joaquin Delta white catfish fishery was being depleted. Primary goal of the investigation was to determine the rate of exploitation of the Delta catfish population and the factors affecting its apparent depletion. A detailed study of the life history of the catfish was also planned. Knowledge about age and growth, food habits, size and age at maturity, reproductive characteristics, and migrations was sought, since this information is fundamental to wise management of the fishery.

Activities of the project were focused on the study of the Delta fishery for the first year. A thorough study of the commercial catfish fishery was completed and was compared with the sport fishery.

Results indicated that the catfish population was under heavy fishing pressure and that the commercial fishery, although a minor one in terms of average annual gross income, was taking a disproportionate share of the annual catch. It also was learned that a number of commercial fishermen were wasting catfish and, in addition, were illegally selling undersized fish.

In brief, the small commercial fishery was producing conflict out of all proportion to its value.

By the end of 1952, the project had sufficient information to justify a recommendation that commercial fishing for catfish be banned in California. It was predicted that elimination of this undesirable fishery would result in improved angling and an increase in size of the individual catfish in the Delta. This recommendation was accepted by the 1953 Legislature with passage of Senate Bills Nos. 44 and 45.

Investigation of the valuable Delta fishery has continued to be one of the most important activities of the project. Two tagging experiments have been conducted to (1) develop a suitable tag for catfish, (2) determine fishing mortality, and (3) obtain information about the movements or migrations of catfish.

### Tagging Study

From these experiments, a dependable catfish tag, the disk-dangler, has been developed and adequate information about the movements of the Delta white catfish has been obtained. A third tagging study is now in operation to determine angling mortality. This additional study was deemed necessary because calculation of mortality rates from previous studies was complicated by the presence of the commercial fishery and lack of confidence in one type of tag that was employed.

A total of 6,966 white catfish has been tagged in the Delta since inception of the project. Anglers who captured tagged catfish have responded well to requests for information pertaining to the catch of such fish with 620 tags returned by July, 1954.

The Foothill Sportsmen's Club of Oakland contributed generously to the tagging publicity cam-

paign by sponsoring semiannual prize drawings for persons who returned tags. Merchandise and cash prizes were awarded to anglers selected at random.

Considerable data concerning life history of the delta catfish is being collected at regular intervals. Although much laboratory work remains to be completed, this phase of the project is progressing well. A check is being maintained on the effect of the removal of the commercial fishery and from all indications the ban was a sound move. Angling seems to have improved and the average size of the catfish definitely has increased.

Since the Sacramento-San Joaquin Delta supplies approximately 50 percent of the catfish caught in California, close contact with the fishery will be maintained for the duration of the project. Information provided by project investigations should enable the department to insure wise utilization of this important resource by regulations based on facts.

Other important catfish areas receiving attention from the project were Clear Lake and the Colorado River. In 1952, 1,500 white catfish and brown bullheads were tagged in Clear Lake in order to determine the rate of exploitation. Returns after one year indicated a minimum annual fishing mortality of only 2.5 percent.

Because of doubts as to the validity of these results, another tagging experiment is planned for the winter of 1955. Food habits of Clear Lake catfish and bullheads are under study also. This work will, among other things, define the degree of competition between catfish and largemouth black bass and the effect of the insecticide, TDE, upon the food supply of the catfish. This insecticide has been used in the control of the Clear Lake gnat.

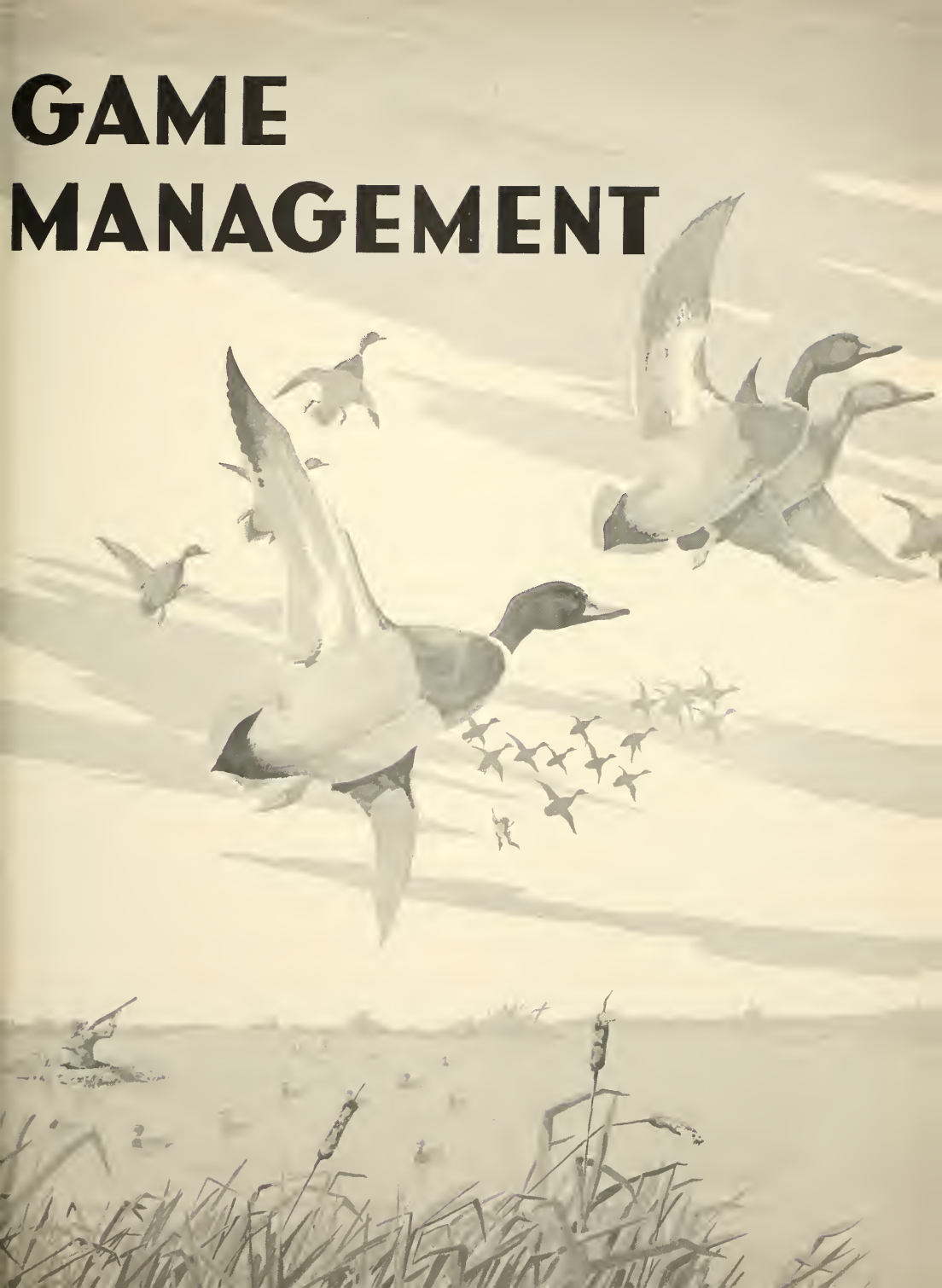
A survey of the Colorado River channel catfish population was conducted in 1954 with several hundred fish tagged and released near Blythe. Tag returns have been numerous in spite of the short interval since the catfish were released. Apparently the Colorado River channel catfish population is under heavy fishing pressure and results of this study will guide the Department of Fish and Game in recommending sensible bag limits.

A survey of catfish populations in Northern California will be made during the summer of 1954 in response to requests by sportsmen for more liberal catfish bag limits in that area.

### Fish Disease Studies

In the spring of 1953 the fish parasitologist's headquarters were shifted to the Berkeley Fish and Game Disease Laboratory of the Game Management Branch. Investigations on diseases of hatchery and wild fish continued. "Trouble shooting" at the hatcheries was actively pursued, and a large number of visits were made to assist the regions with the prevention and control of disease.

# GAME MANAGEMENT



*Record and near-record bags recorded for most species.*

*Four new waterfowl public hunting areas added.*

*Game habitat development emphasis placed on deer.*

*California receives largest Pittman-Robertson apportionment to date.*

*Game resources appear to be holding their own.*

## GAME MANAGEMENT

Game Management activities during the biennium were carried out by the department during a period of record or near-record bags of most game species, and constantly increasing hunting pressures in every part of the State. Through constant efforts to provide improved habitat conditions and sound game management, the resource appears to be holding its own and in some cases showing gains.

At the same time great strides were being taken along the lines of keeping the game resource in sound condition, equal steps were made to provide more opportunities for public shooting for sportsmen of the State. During the biennium important additions and improvements were made in the field of pheasant cooperative areas, waterfowl management areas, public shooting areas for deer, and in winter deer ranges.

Following reorganization of the department, effected during the biennium, the Game Management Branch of headquarters staff coordinates the Pittman-Robertson federal aid in wildlife restoration program, directs research activities, keeps records and prepares statistics and acts in an advisory and coordinating capacity for regional matters. Preparation of policy recommendations on game management and regulation is another function of the branch.

Operational functions of Game Management such as maintenance of waterfowl management areas, pheasant cooperative hunting areas, investigation and control of game depredations, predator control, trapping and transplanting beaver, game range examinations, maintenance of winter deer ranges, raising and stocking of game farm birds, operation of public hunting areas and numerous other miscellaneous activities were conducted as regional functions.

Other important activities of the branch during the biennium included active participation in the work of the Pacific Waterfowl Flyway Council, made up of representatives of the western states who make recommendations to the U. S. Fish and Wildlife Service on setting open seasons and attempting to solve various problems of the flyway; participation in an interstate committee on deer browse restoration problems common to most western states, and working closely with Oregon and Nevada in management of deer herds which have interstate migration patterns with California.

The council, on which Chairman William J. Silva of the California Fish and Game Commission was an active member, and Game Management Branch Chief Ben Glading, secretary, was instrumental in obtaining more liberalized seasons and bag limits for California hunters during the past biennium.

Through efforts of the council several special waterfowl seasons were authorized as crop depredation relief measures. Among these were the 1953-54 late winter widgeon season in Imperial Valley, the late brant season, and a coot reduction season in the spring of 1954. As a further crop relief measure prehunting season feeding was authorized for duck clubs on a licensed permit basis.

### THE GAME HARVEST

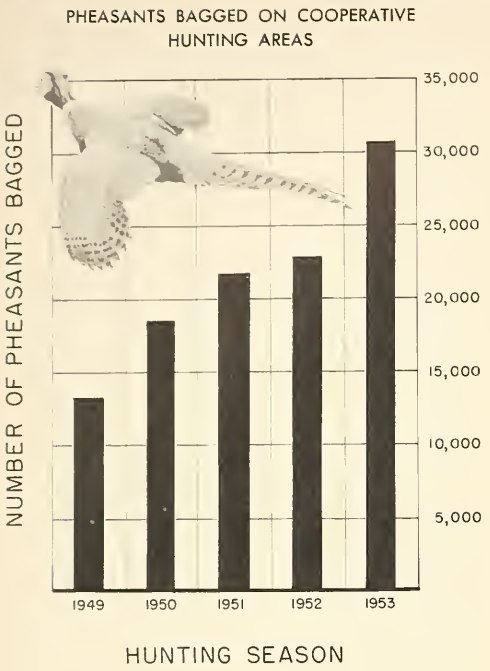
Game bags of most species showed a high level during the biennium and record kills were reported for many. At the same time game population remained at good levels in spite of tremendous hunting pressure, which was an important factor in the increased bag. Statistics on the game bag were compiled from hunter questionnaire surveys and from a tabulation of deer tags.

Indications are that despite the present high population levels, game will continue to suffer from encroachment of agriculture and industry unless wildlife is given its proper place in planning for future development of the State. Most likely to suffer a reduction in numbers are waterfowl, whose habitat has been subject to constant decrease over the years.

With deer, the most pressing problem is a more adequate use of the resource by harvesting more animals. Field investigations by the branch have shown that present deer populations in many sections of the State are overusing their range to the point of seriously damaging the food supply. Failure to harvest the annual increase in deer population, which is the case today, will result in the deer herds adjusting their own numbers by periodic and wasteful die-offs and herd increases—a boom-and-bust routine.

For a better understanding of the total bag figures, the essentials of the hunter questionnaire system are summarized. The hunter questionnaire has been standard procedure since 1948, and is a statistical process recommended by the Opinion Research Center of the University of Denver. Questionnaires are sent to a 2-percent random sampling of hunting license buyers. Resulting data is considered typical of the entire hunting public and projected mathematically to get a statewide figure. Exaggerated results are obtained through such a system, but the factors leading to the exaggerations remain constant from year to year so that the indicated trends of game bag are considered reliable. Answers are checked with expected hunting prospects as determined by field surveys, and through combining the two sources of information valuable data is obtained.

More accurate figures on pheasants and waterfowl bag were obtained by checking the questionnaire results with known bag on cooperative hunting areas and on waterfowl management areas. Interestingly enough




the number of hunters using these areas tallied closely with the projected number from questionnaire figures.

Bag and population levels of the various species:

**Quail:** Two successive mild winters and improved precipitation in desert areas have resulted in a general increase in quail throughout the State. These conditions were reflected in the highest bag on record reported for 1953.

**Pheasants:** An exceptional hatch of birds in the spring of 1953, as indicated by field surveys, and increased hunting pressure resulted in the best bag on record. Pheasant tag sales have indicated a continued increase in the popularity of the ringneck as a game bird.

**Doves:** Year after year doves produce the second largest bag of any game species, and population remained good during the biennium with a record made in the 1953 bag.

**Pigeons:** Although the 1953 pigeon bag was the second best ever recorded, the previous year was light. These birds show an erratic distribution pattern from year to year, with marked fluctuations in the bag which may have no relation to the numbers of birds present.

**Ducks:** Ducks have consistently produced the greatest bag of any of the game species, and the two seasons during the biennium were no exception. During the two-year period there was a marked increase in ducks wintering in California, as shown by the yearly census conducted jointly by the department and the U. S. Fish and Wildlife Service. Reflecting this increase was the record year for 1952, and a close second in 1953.

**Geese:** Hunter bags for geese reached all-time highs during the biennium. Best year for goose hunters was 1953.

**Rabbits:** Rabbit hunting is assuming more and more importance in the state-wide picture, as shown by the fact that the combined total of cottontails, brush, and jackrabbits taken exceeds the number of some of the more popular game species such as quail, pheasants and geese. Rabbits are taken mainly in the southern part of the State, where there are large numbers of hunting license holders and a limited amount of other game close at hand.

**Bear:** California bear hunters had their best year in 1953, although relatively few hunters seek bears, probably because well-trained dogs are a near-necessity for successful bear hunting. Many bears are taken while the hunters are out after deer.

**Deer:** After the severe winter of 1951-52, the 1952 deer kill fell off sharply, although the following year the bag climbed sharply to the second best season on record. Recovery in deer population was especially noted on the east side Sierra ranges which were hardest hit by the severe winter. Other factors contributing to a lower 1952 kill were the return of forked horn protection in District 1¾, and mild weather which kept the deer on high summer ranges where hunting was difficult. Mild winters, in 1952-53 and 1953-54 brought about marked state-wide increases in the deer herds.

**Tree Squirrels:** Tree squirrels are a minor game species, although 1953 saw the second highest harvest on record. The previous year showed a small kill.

**Jacksnipe:** Relatively few birds were bagged in 1953, the first open season on the species since 1940. Most were taken by duck hunters incidental to their main quarry.

### State-wide Game Kill—1948-1953

As reported by hunters in postcard surveys

| *Species* | *Yearly average indicated bags 1948-1951* | *1952* | *1953* |
|---|---|---|---|
| Quail | 1,352,100 | 1,644,700 | 2,041,400 |
| Pheasants * | 476,700 | 581,800 | 732,400 |
| Doves | 2,146,200 | 2,595,200 | 2,909,100 |
| Pigeons | 167,000 | 177,400 | 294,200 |
| Ducks | 2,549,000 | 4,642,800 | 4,599,600 |
| Geese | 310,200 | 490,300 | 580,500 |
| Rabbits (brush, cottontail) | 443,900 | 504,800 | 949,400 |
| Jackrabbits | 719,000 | 986,700 | 1,188,100 |
| Tree squirrels | 48,000 | 26,700 | 66,400 |
| Bears | 3,300 | 5,200 | 7,200 |
| Jacksnipes (first open season since 1940) | .. .... | ..... | 44,200 |

* Includes pheasants taken on licensed game bird clubs.

## FUR RESOURCES

Although not widely known, California still has a sizable and valuable fur resource. During the past biennium 1,851 fur trappers were licensed and took 199,000 fur-bearing animals with an estimated value of $196,000 for raw furs. Inasmuch as trapping is closely linked with market demand, about 90 percent of the animals were muskrats. Current fashions result in demand for the so-called short hair varieties such as muskrat, mink and river otter, and trapping effort is largely directed toward these species. Conversely, such abundant species as gray fox, raccoon, bobcat and coyote have little value, and are virtually unused on the present fur market.

### Cooperative Hunting Program

For the past two years there has been a steady upswing in the department's cooperative pheasant program, from the standpoint of number of co-op areas, acreage involved, shooter capacity, number of hunters using the areas, number of pheasants bagged, and percentage of hunter success.

Since the program was initiated in 1949 by action of the Legislature, it has seen a steady growth in popularity as a means of providing shooting for the unattached pheasant hunter. Crux of the program is agreement between private property owners and the Department of Fish and Game whereby the owner allows public hunting on his property under the regulation and supervision of the department. Permits are issued at checking stations to the hunters on a first come, first served basis. Cooperative areas are patrolled by department personnel to insure compliance with the agreement and with the regulations.

By the 1953 season a total of 142,500 acres of land was opened in 18 cooperative areas from Firebaugh in Fresno County in the south to McArthur in Shasta County in the north. That year 72,841 hunters, or about one-fourth of the total, were accommodated, and 30,698 pheasants taken. Of these co-op areas, 16 were free to the public, and two were charge areas, on which no more than $2 daily can be charged for the hunting privilege.

For a complete listing of areas, number of hunters, and hunting success, see Table 31, Appendix.

### Pheasant Hunting on Waterfowl Areas

An innovation during the biennium was opening of certain waterfowl management areas to pheasant hunting. In 1953 Gray Lodge provided shooting for 1,586 hunters and a bag of 872 birds; Los Banos, 215 hunters and a bag of 80; Grizzly Island, 147 hunters and a bag of 85; and Honey Lake, 838 hunters and a bag of 369 birds.

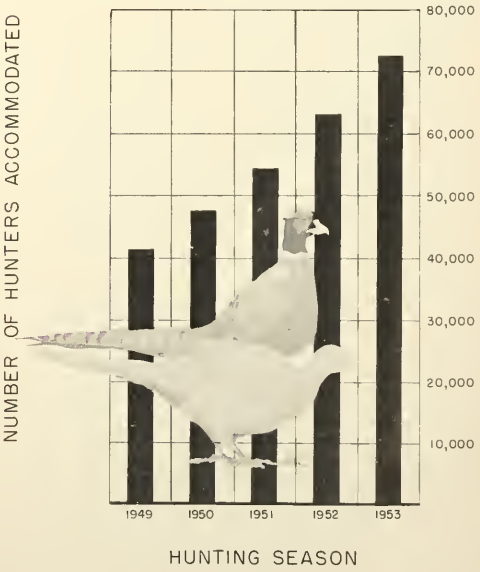
Grizzly Island and Los Banos hunting was set aside for juveniles, 16 and under, who were accompanied by adults.

## WATERFOWL MANAGEMENT AREAS

California is justly proud of the quality of shooting on its public waterfowl hunting areas, which have continued to expand during the past biennium. Examples of this are the average bag per hunter of four birds at Gray Lodge, Butte County, and 3.5 birds at Grizzly Island, Solano County, better than reported from any other public shooting ground in the United States. Four new areas were added during the biennium, including Gray Lodge, Sutter National Refuge, San Luis Wasteway, and Los Banos. Sutter Refuge is in Sutter County, and the latter two are in Merced County. Another factor in the expansion was the addition of the first cooperative waterfowl hunting area, the Welch area in Colusa County. Additional shooting was provided by leasing at low cost 5,000 acres known as the Napa Marshes unit from the Leslie Salt Company. These units, covering 24,775 acres in 1953, brought shooting to 37,000 hunters who bagged 98,201 waterfowl. These figures do not include the take at Napa Marshes, where no checking stations were maintained for accurate records. However, 1,650 permits for use of the area were sold.

Public shooting areas are of three main types: state land such as Gray Lodge and Grizzly, Lea Act lands owned by the Federal Government with the hunting supervised by the State, such as Sutter and Colusa

GROWTH OF PUBLIC SHOOTING PROGRAM
PHEASANT COOPERATIVE HUNTING AREAS

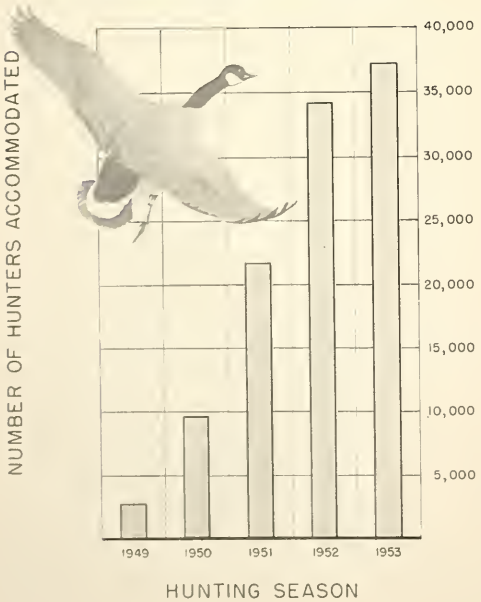


areas; and leased lands such as the San Luis Wasteway, from the U. S. Bureau of Reclamation, and the Napa Marshes, from Leslie Salt Company.

Hunters using most public shooting areas were charged $2 per day, which goes toward defraying expense of maintaining and operating the area. Madeline and Honey Lake were free areas, and on that part of the Imperial area where blinds were available the charge was $5 per day. At Napa Marshes a $3 seasonal permit was issued.

All waterfowl management areas have zones which are closed to hunting, providing waterfowl feeding and resting areas. On all Lea Act lands and on some state lands such as Gray Lodge and Los Banos, hunting usually is delayed until harvesting on surrounding agricultural areas is completed as a crop depredation relief measure. Total acreage of both state-owned and federally owned waterfowl areas showed big increases during the period of this report. In 1951 the state-owned or leased total was 33,584 acres, and by 1953 this total had reached 45,457. Federally owned waterfowl areas, parts of which are opened to hunting, rose from 177,507 acres in 1951 to 180,190 in 1953 mainly through addition to the Colusa and Sutter areas. These figures include all federally operated areas in addition to those operated partly as state-controlled public shooting grounds.

GROWTH OF PUBLIC SHOOTING PROGRAM
WATERFOWL MANAGEMENT AREAS




### Variety of Sources

Funds for acquisition of the state and federal waterfowl areas come from a variety of sources: from Pittman-Robertson federal aid in game conservation by a tax on sporting arms and ammunition; from the Federal Lea Act which sets up funds for purchase of land to prevent crop depredation by waterfowl; funds of the Wildlife Conservation Board, which was allocated funds from race horse pari-mutuel betting; and from the sale of hunting licenses.

Each area has several purposes in the State's waterfowl management program. These lands provide feeding and resting areas, to prevent damage to nearby agricultural crops, to provide a sanctuary during hunting season, nesting areas, and as public shooting grounds for licensed hunters. Major purpose is perpetuation of a natural resource whose wintering grounds has been seriously depleted.

A large portion of Pittman-Robertson funds available for development work has been spent in waterfowl management areas because waterfowl are in greatest danger of being adversely affected by the continuing economic development of the State.

Work at the various areas included land leveling, ditch construction, levee construction, installation of head gates, building construction, cultivation of waterfowl food crops, and road construction.

Following is a summary of the management areas on which development work was carried out under Pittman-Robertson funds:

1. **Suisun Waterfowl Refuge:** Encouraging the growth of native aquatic plants for waterfowl feed was the purpose of P-R Project W9-D in the development of this 1,887-acre salt-water marsh area in Solano County. The area does not lend itself readily to cultivation of food crops of domestic varieties. No public hunting is provided, as the area's function is solely that of a refuge.

2. **Gray Lodge Waterfowl Management Area:** Cultivation of waterfowl food crops was a major activity on this area, located in the heart of California's rice-growing region in the upper Sacramento Valley. Production of food crops is important in relieving crop depredations by holding peak waterfowl populations on the management area. Development of the crops, carried out under P-R Project W13-D, saw 1,500 acres of rice, milo, millet, barley and wheat grown, out of a total area of 2,542 acres. Public hunting was provided on a portion of the area beginning in 1953.

3. **Imperial Waterfowl Management Area:** Size and effectiveness of this area in providing waterfowl feeding grounds and public shooting areas has been reduced due to the rise in elevation of Salton Sea waters, and its encroachment on the waterfowl area. Most of the area was lost to flooding, leaving less than 1,000 acres. Development of the area was done under P-R Project W36-D. Because of the importance of having waterfowl feeding and resting grounds in the intensely

farmed Imperial Valley, an alternate site is being obtained through use of Wildlife Conservation Board Funds.

4. **Honey Lake Waterfowl Management Area:** Development of this 4,820-acre area in Lassen County was carried out during the biennium under P-R Project W38-D. It is an important nesting ground for ducks and Canada geese. About 800 acres of waterfowl food crops were under cultivation, mainly wheat and barley. Public shooting is provided.

5. **Madeline Plains Waterfowl Management Area:** Another P-R development project was the Madeline Plains area, which is an excellent waterfowl breeding area and which has a large resident population of Canada geese. Approximately 700 acres of waterfowl food crops such as wheat and barley are in cultivation. During mild winters there is good public hunting for ducks and geese. This area was under P-R Project W39-D.

6. **Los Banos Waterfowl Management Area:** Like Gray Lodge, this area is important in providing crop protection for surrounding agricultural areas. More than 800 acres of waterfowl food crops were cultivated, keeping thousands of birds on the area and away from San Joaquin Valley crops. Public shooting is provided on a portion of the 3,000 acres in the area.

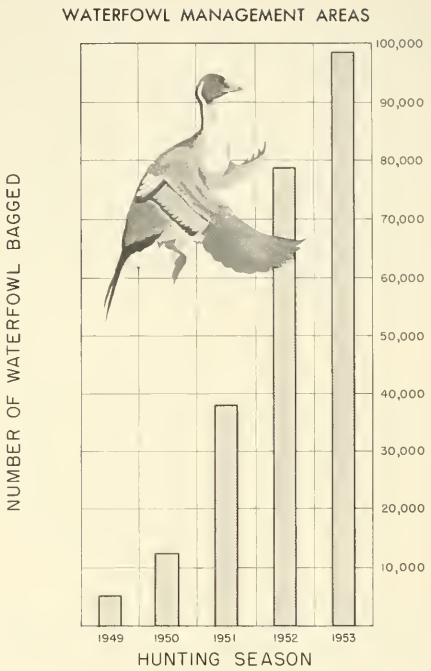
7. **Grizzly Island Waterfowl Management Area:** This area, largest of California's waterfowl management areas, with 8,600 acres, was purchased in 1950 with funds provided by the Wildlife Conservation Board. During the biennium nearly 28,000 hunters were accommodated, with 85,000 birds bagged. Located close to the heavily populated San Francisco Bay region, it provides a convenient and excellent shooting area for a large number of sportsmen. Approximately 2,000 acres of waterfowl food crops was under cultivation under P-R Project W43-D.

## UPLAND GAME BIRD PRODUCTION

During recent years virtually all suitable ring-neck pheasant habitat in the State has been adequately stocked, and the biennium saw game farm birds used for stocking for the gun. Stocking to extend the pheasant range no longer is the prime purpose of the farms, and most birds are held to maturity and released just prior to or during the pheasant season.

During the two-year period covered by the report the department's game farms released 191,772 upland game birds, of which 187,485 were ring-neck pheasants, 1,955 Reeves pheasants, and 2,332 chukar partridges. The department's facilities for holding birds are supplemented by sportsmen's pens located throughout the State. During the biennium 62,366 pheasants, both male and female, were released from pens maintained by sportsmen's organizations.

Policy for release of game farm birds has been to release most on areas for public hunting, with a considerable number on cooperative areas. A few birds are released on land which is closed to hunting for five years, to be considered seed stock areas. No birds are released on habitat totally unsuited to pheasants.




**Reeves Pheasants:** Efforts were made during the biennium to etablish the Reeves pheasant in timbered country and coniferous forests, territory similar to that inhabited in its native China. It was hoped that the Reeves pheasant would take hold and provide hunting in areas now lacking in upland game birds with the single exception of the mountain quail, but success to date has been nil. The few birds planted during the biennium were placed in entirely new areas such as the heavy rain forests of Del Norte County. The department has dropped this species for further introduction.

**Chukar Partridge:** In direct contrast to the Reeves pheasant, the chukar partridge, another Asiatic native, has established itself to the point where California's first open season was authorized for the fall of 1954. Chukars raised on game farms are used to establish new colonies of these birds in suitable habitat not now occupied by permanent population. Game farm chukars usually are supplemented by wild birds obtained by trapping, in planting a new site.

Total plant of chukars from the beginning in 1928 to the present has been 47,000 birds.

(See Table 29, Appendix, for game bird releases.)

*Numbers of the imported chukar partridge increased so much that the first open season was authorized in 1954. Chukars are shown at the lip of a quail guzzler.*

Best habitat for this steadily increasing game bird is in the arid mountain country east of the Sierra crest, the southeast desert ranges and the barren hills surrounding the southern part of the San Joaquin Valley. Although game farm birds were used to a certain extent in the southern part of the State for transplanting, much of the success in spreading birds has been done by trapping and transplanting wild chukars.

## GAME HABITAT DEVELOPMENT

Under the Pittman-Robertson Project W26-D most of the major habitat improvement work of the department for species other than waterfowl was accomplished. The project is state-wide in scope with work done in all of the five regions.

During the preceding Biennium 1950-52 this project was concerned primarily with restoration of quail range. Activities included food and cover plantings, erecting artificial roosts and construction of "gallinaceous guzzlers" or artificial watering devices. During the past biennium emphasis was shifted to deer habitat improvement although the quail work continues, but on a reduced scale. The program receives help through financial aid from county fine moneys and physical labor from sportsmen and other interested groups.

Listed below are the major activities of the project.

1. **Artificial Quail Watering Devices (Gallinaceous Guzzlers):** These rain catchment basins have proved effective in furnishing water for quail. As a consequence many areas formerly deficient in water are now productive hunting grounds. During the biennium 239 guzzlers were installed bringing the total to 2,016. Although primarily for quail these watering devices have proved beneficial to chukars and doves. Most of the guzzlers are located in the central and south coastal counties and in the southeast desert areas where water deficiencies are most prevalent. Plastic has been substituted for concrete as construction material in more inaccessible areas.

2. **Spring Development:** A continued program of spring survey and development work has been carried on, mainly in the southeast desert mountains. Quail, doves, chukars, and bighorn sheep are the principal beneficiaries of this work. Activity consists primarily of surveying water sources and developing by boxing, piping, and cleaning those springs which show promise of furnishing year-round water. More than 100 springs were improved.

3. **Brush Removal on Deer Ranges:** California has vast acreages of mature, dense brush stands which are low in game productivity. By clearing and opening up these stands to permit deer access they can be made into good habitat. In addition to providing access, the new sprouting growth on the cleared areas provides increased feed for deer and other game.

Methods developed by the department's brush removal P-R research studies are being employed in this work. Mechanical removal and controlled burning of brush are the two methods in most common use. Burning and mechanical removal are done in small patches and strips so that the area benefited is actually many times the acreage of the cleared land itself.

During the biennium over 3,000 acres were cleared mechanically and nearly 1,700 acres were control burned. Nearly 800 acres have been chemically treated to retard growth of undesirable species or fertilized to promote growth of desirable species. Chemical treatment of brush lands is in an experimental stage at present, but gives promise of more use in the future.

4. **Reseeding of Deer Range Lands:** During the biennium nearly 5,000 acres have been seeded, mainly to grasses and other herbs such as filaree and clover. Some experimental reseeding of desirable browse species has been done also. Range reseeding is done on controlled burns and on wild fire burns. In addition to the feed provided it has been found that a good growth of grasses and herbs on a new burn has a tendency to reduce the amount of reinvasion of brush on the area by choking out the seedlings.

5. **Shrub Plantings:** More than 50,000 shrubs were planted in Siskiyou, Modoc, and Lassen Counties in range improvement work. Bitterbrush, multiflora rose,

wild rose, willow, and other species have been used. Local ranchers and sportsmen have taken an active part in the program in the form of furnishing tractors and labor for the work.

6. **Deer "Guzzlers":** Two deer-watering devices have been constructed in the Andesite area in Siskiyou County. The locality is in an excellent stand of bitterbrush which is at present little utilized by deer because of a lack of water in the area. It remains to be seen whether these guzzlers will accomplish their purpose.

## SPECIAL DEER SEASONS

Ten special deer hunts were authorized by the California Fish and Game Commission, with a variety of objectives. Some were for relief of farmers who had suffered crop depredations, some to protect winter ranges from over-browsing, others to provide better harvest of deer herds which were unreachable during the regular season, and still others to provide hunting in areas of fire hazard during the regular season.

Special hunts may be sponsored by local groups, or by the department, but in each case open public hearings are conducted and if local opinion is favorable, plans for the season are drawn up. Commission policy has been to authorize special hunts only if they have local backing. A total of 2,776 deer were taken in the special hunts held during the biennium. A summary of the special hunts:

**Los Angeles Archery:** These hunts, held from July 26 to October 19, 1952, and from August 8 to December 31, 1953, were set up for the purpose of allowing deer hunting in the heavily populated Los Angeles area where rifle hunting was felt to be too dangerous. With either sex provisions, 16 males and 14 females were bagged by archers last year. No data was available on the previous season's hunt.

**Southern California Winter Season:** Fire closures in Southern California national forest areas for many years have denied a major deer territory to Southern California hunters. In January of 1953 a 16-day season for either sex was set up, with a kill of 700 males, 427 females and 26 unclassified for a total of 1,153. The following special season, for bucks only, saw a kill of only 191. The second season was for 11 days only, and was held during a period of high winds and fire danger. Because of postponements, interest lagged. There was an antler drop during the period, further cutting down the number of animals taken. Hunter success was low for both years, with a 13 percent success ratio in 1942 and only 6 percent the following year. Despite these figures, the majority of sportsmen participating appeared to favor continuing the winter seasons.

**Fillmore-Ojai Hunt:** This hunt for antlerless deer was authorized as a result of local crop depredations by deer. During the 15-day hunt in September, 1952, 190 deer were bagged in the Ventura County areas.

**Coloma Hunt:** This hunt, authorized for the foothill area of El Dorado County around Coloma, resulted in 191 antlerless deer being taken. Its purpose was to give relief to orchard and pasture land which had been suffering from deer damage.

**Barton's Flat:** (Fresno and Tulare Counties) November 16 to November 29, 1952; November 15 to November 29, 1953. These two hunters' choice hunts were authorized in order more adequately to harvest the deer that winter on the Barton's Flat winter range. Many of these animals summer in the King's Canyon National Park and are usually unavailable to hunters during the regular season. During the two seasons 319 males and 329 females were bagged; total 648. Hunter success was good with 89 percent successful the first season and 56 percent the second.

**Glenn-Colusa Area:** This antlerless deer hunt was conducted from October 31 to November 16, 1953, in order to relieve crop damage in the Stonyford area. A total of 271 deer were bagged. Hunter success was a high 82 percent.

**Camp Pendleton Marine Base:** This hunt November 28 to December 5, 1953, was on Marine Base property for service personnel. Hunter success was 100 percent as 102 antlerless deer were taken.

### Licensed Game Bird Clubs

Originally the plan for these areas was adopted by the 1939 State Legislature to stimulate the landowner's interest in the game crop. Through this plan it was intended to foster and increase the supply of upland game through land management and stocking of privately raised game farm birds.

Backers of the plan believed that the income derived from the game crop would provide an incentive to the landowner to manage his land for game production,

*Clearing strips of brush allows access by game, and provides food in the form of new sprout growth.*

primarily pheasants. Since these areas were to be open to any licensed hunter the income from the game produced was to be obtained by charging hunters up to a designated maximum fee for shooting privileges. In actual practice the income produced from hunting could not compete with farm crops being produced. In addition the landowners found it difficult to control hunting on these areas.

In 1947 the Legislature modified the plan to allow noncommercial or private clubs to be set up where the general public could be excluded. These private areas are now supported by season memberships or by a share the cost arrangement with the operator. In 1951 the Legislature established the name Licensed Game Bird Clubs for these areas (formerly they were known as Game Management Areas) and made modifications in the law in regard to season, license fees and size of areas.

Since the law was changed to permit noncommercial or private clubs the system has shown a steady growth. In 1953 the season extended from October 31, 1953, to January 13, 1954. Seventy-two game bird clubs were in operation, liberating 43,721 birds and bagging 28,375 birds in 14,053 man days of hunting. These clubs now control 62,208 acres of land.

Of the 72 clubs now in operation 70 are private and two commercial. Sixty-six of these clubs are located in Region II with the remaining six scattered in the other four regions. All are pheasant clubs with the exception of one operated for both pheasants and quail.

### Disease Laboratory

Ultimate objective of the disease prevention phase of game management is the control of disease occurring in wildlife throughout the State. Positive steps have been taken to realize that objective during this biennium.

*The department's disease laboratory, which allows on-the-spot investigation of wildlife diseases.*

Those steps included anticipating epidemics and devising effective methods of control prior to the outbreaks; gathering facts and observing the natural history of diseases as they occurred in the wild; and maintaining close coordination with other state agencies in order to prevent or limit transmission of communicable diseases between domestic stock, wildlife, and the public at large. A portable laboratory is maintained for on-the-spot investigations. As an illustration of these points, the following examples may be cited.

**Botulism:** Excessively heavy snowfall in the Sierra Nevada Mountains during the winter of 1951-52 promised flooding of the Tulare Lake Basin. Through a knowledge of past conditions, it was anticipated that botulism would exist during the following summer. The most feasible procedures were put into effect to control that disease during the biennium. They included a coordinated effort to (1) herd ducks from affected areas by plane, air-thrust boat, and through the use of pyrotechnics, (2) maintain water movement by pumping operations through the cooperation of the farmers in the area, and (3) distribute feed elsewhere through the cooperation of the U. S. Fish and Wildlife Service to hold the waterfowl in a non-toxic area. Evaluation of this work indicated a reduction from a past 20 percent mortality to a mortality of about 1 percent.

**Fowl Cholera:** There were two outbreaks of fowl cholera during the biennium, neither of which grew to epidemic proportions. These occurred in the Alvarado area of Alameda County, in March, 1953, and in the south San Francisco Bay in December of the same year. Around Alvarado about 1,000 dead birds, mostly gulls and coots, were found. The south bay toll included ducks, coots, and gulls. Less than 200 ducks died.

To prevent further spread of the disease, the department cleaned up the carcasses to prevent feeding on them by gulls, believed to be one of the carriers of the disease.

To confirm this theory, gulls and coots were inoculated with virulent organisms. A million times as many organisms were required to kill gulls than coots, tending to show that gulls were resistant carriers of fowl cholera. As a result of this experiment, it is believed that control of gulls at the outbreak of fowl cholera will limit spread of the disease to epidemic proportions.

**Stomach Worms:** The prevalence of round worms in the intestinal tract is considered as one of the more important factors limiting the number of deer in the north coastal counties, although there were no severe outbreaks during the biennium. A survey concluded during the biennium determined the relative incidence

of the various species of worms (helminths), and ostensibly confirmed the theory that younger animals are more susceptible to infection and therefore more apt to succumb to the effects of these parasites. A study of the relation between various nutritional states and intensity of infection is now underway. Deer suffering from malnutrition are more susceptible to the disease.

**Cooperative Disease Studies:** Investigations have been made in cooperation with other state agencies and institutions on diseases related to the welfare of wildlife species as well as to domestic stock and public health. Blood samples obtained from wildlife species have been submitted to the State Department of Public Health for a determination of the presence of diseases transmissible to man, with all results to date being negative. Sera of wild avian species have been tested for virus diseases transmissable to poultry. In cooperation with the State Department of Agriculture and the University of California, diseases capable of passing from livestock to wildlife have been investigated jointly. As a result, serious threats to wildlife have been averted by the prompt and combined action of the interested agencies.

In addition, Pittman-Robertson Project W35-R is devoted to investigation of wildlife diseases which can be controlled by management practices.

### Mountain Lion Control

During the biennium 355 mountain lions were bountied, 89 by State lion hunters and 266 by private individuals. Of this total, 174 were taken in 1952 and 181 in 1953. The bounty is $50 per male lion and $60 per female. Table 26 of the Appendix is the county breakdown as to the mountain lion kill.

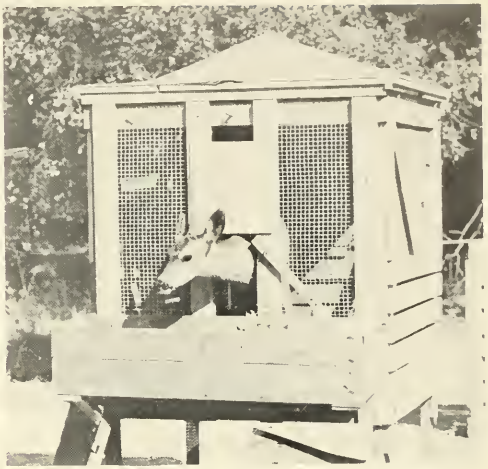
Department policy in regard to taking lions is to maintain a control over their numbers rather than trying to eradicate the species. State lion hunters hunt areas where sign shows the lions to be excessively numerous.

There were four Department of Fish and Game lion hunters in 1952 and three in 1953.

### Predator Control

During the biennium 3,779 coyotes, 1,945 bobcats, and 8,685 lesser predators (skunks, opossums, raccoons, etc.) for a total of 14,409 were taken by department predator control men. In predator control it is the policy to trap predators where their removal will afford maximum protection to the game crop. As a consequence, particular attention is given to trapping on known deer fawning areas, antelope kidding grounds, waterfowl nesting areas, and pheasant nesting areas, especially where public hunting access is allowed.

Table 26 of the Appendix is a county breakdown of predator control activities.



*An evaluation of deer foods is made with this experimental feeding pen. Native browse and artificial foods are mixed in the diet.*

### Predatory Birds

During the biennium the State paid a bounty of 15 cents per bird for crows and 10 cents per bird for black-billed magpies. 1,681 crows and 191 magpies were bountied during the period.

### Wildlife Conservation Board Projects (related to game)

Activities which have received the benefits of Wildlife Conservation Board programs to date include the constructon of game farms, quail habitat improvement, acquisition of deer winter range, and acquisition of waterfowl management areas. The bulk of the funds for wildlife have been directed toward the acquisition of waterfowl management areas.

## SURVEYS AND INVESTIGATIONS

During the biennium California received $1,680,968 from federal aid funds, the largest apportionment to date from the federal excise tax on sporting arms and ammunition under the Pittman-Robertson Act. California's contribution, as required by the act, amounted to $560,322, for a total Pittman-Robertson Fund of $2,241,290.

These funds were channeled into 22 projects, all of them aimed at improving the wildlife resource either through research and investigation or development of habitat, management areas, and public shooting grounds.

Eight of these projects were in the field of surveys and investigations, aimed at acquisition of knowledge which will enable the public more fully to understand the problems of its wildlife resource, and the department to more efficiently and intelligently manage it.

*Canada geese are banded by the waterfowl study team at Honey Lake, Lassen County. This is one of the State's major breeding grounds for the big "honkers."*

Others are in development, land acquisition, maintenance and coordination. Following is a summary of the survey and investigation projects and their aims. Development projects are summarized under their various management functions.

**Food Habits Investigations, Project W25-R:** Food habits information gained mainly through stomach analyses is an integral part of wildlife management studies now being conducted by the department. Information gained on nutritional value of native deer browses and other deer food habits has been valuable in helping formulate deer management plans for herds throughout the State, and in determining possible range improvements.

Other species in which investigations have been made included coyotes, bobcats, pigeons, chukars, quail and waterfowl. Knowledge gained in these studies enables the department to recommend intelligent control measures against predators, and in the case of game birds is used in developing new food plants, in planning waterfowl management areas, and in determining possible new locations for introductions or planting of various species.

In addition, the food habits laboratory, as time allows, has done work for six other western states. The department is reimbursed for this work on a labor cost basis.

**Study of Production, Migration and Wintering Areas of Waterfowl in California, Project W30-R:** Value of information gained through investigations and surveys of waterfowl numbers, scope and condition of breeding grounds, resting areas, and degree of kill is tremendous in setting of seasons and bag limits. This material, gathered painstakingly by department field men, and correlated by the staff, is weighed each year by the California Fish and Game Commission, the Pacific Waterfowl Flyway Council, other states on the flyway, and federal agencies in the formulation of policies and regulations.

As California is the main wintering ground of the entire Pacific Flyway, data gathered here is of vital importance to all western states. Main phases of the project are:

1. Winter Inventory of Waterfowl. An annual winter inventory is conducted in order to determine any rise or fall in over-all waterfowl populations. Armed with this information, recommendations may be made for changes in seasons or bag limits. This has been a joint program of the department and the Fish and Wildlife Service.

2. Breeding Grounds Survey. The major breeding grounds within the State are surveyed in the spring in order to determine the local production of ducks and geese. An aerial census of paired waterfowl and actual nesting studies are phases of the project.

3. Banding Operations. An extensive waterfowl banding program has been in progress. This study yields data on migration patterns and mortality of various species as affected by hunting pressure. During the two-year period, 68,732 birds, including ducks, geese and coots, were banded. The rate of return averaged 15 percent.

4. Bag checks to determine the degree various species of waterfowl enter into the over-all kill.

5. Duck Club Survey. Annual records are kept on hunting success on the various duck clubs in the State.

This yields additional important data relative to determining the over-all waterfowl hunting success by year.

6. Wood Duck Nest Boxes. A study is in progress in order to determine the feasibility of putting up artificial nesting sites for wood ducks as a management aid in increasing this species in California.

**Big Game Studies, Project W41-R:** Development of management techniques for sound management of California's big game species is the aim of this study.

1. Deer Herd Studies. This phase of the project conducts studies of deer populations in specific areas throughout the State. The scope of the studies include population numbers, herd composition counts, herd productivity, migration patterns, effects of hunting pressure, range use and condition, trapping methods, food habits, predator relationships, and agriculture and livestock conflicts. Successful management of the herds would be impossible without the information gained in the studies.

2. Antelope. Studies on methods to increase production of antelope herds is a new phase of the project. Particular attention is directed toward evaluating the effects of predation on antelope kidding grounds and determining other causes of kid mortality. An annual aerial count of antelope numbers is conducted to keep close tab on any rises or falls in the over-all population.

3. Bighorn Sheep. Preliminary work on determining the population of bighorn in California is the initial phase of this study. Possible management of this species through spring development in desert mountain ranges where this species occurs is being investigated.

**Effects of Economic Poisons on Wildlife, Project W45-R:** Another project under service agreement with the University of California, its purpose is to determine beneficial and detrimental effects of those chemicals and methods of application used in agriculture, forestry and other related fields.

Particular attention is being paid to chemicals having toxic effects on wildlife, and in developing safe practices in use of these agents.

**Project W46-R Game Range Restoration:** This project is being conducted under a service agreement with the California Forest and Range Experiment Station.

Its purpose is to develop practical means of increasing desirable deer browse species on depleted ranges. Particular emphasis is being paid to east side Sierra areas where problems of deer browse shortages are especially acute. Propagation of range plants by seeding and cuttings are under experimentation. Bitterbrush, an important and highly palatable range plant, is receiving special attention. The possibility of introducing new species into the area is also being investigated.

**Effects of Brush Removal on Game Ranges in California, Project W31-R:** Under a service agreement with the University of California, sound management of brush lands in California is being investigated, and methods of improving deer and quail productivity on these lands studied. Results of these investigations and experiments are a definite improvement of carrying capacity for wildlife, not only on the burned and cleared areas, but on surrounding territory. Increased

*Results of a controlled burn in Tuolumne County. This area has been reseeded with orchard and Harding grass. The thick stand of grass tends to retard re-invasion of brush.*

*A cannon net trap, fired over pigeons watering at a spring, a successful method of capture for banding.*

numbers of deer, quail, and doves have resulted from controlled burns.

Experiments were made in controlled burning, mechanical clearing, chemical treatment, and in reseeding of cleared areas. Burning appears to be the cheapest and most effective method when followed by reseeding.

**Project W47-R Upland Game Investigations:** This project has several phases as listed below.

1. Pheasant. Studies involve evaluation of the effects of releasing game farm birds; brood counts to determine the yearly production of pheasants in the wild; effects of agricultural practices on pheasant populations; and investigations into effects of hunting pressure. Hunting season controls as they apply to hunters and land uses are being studied to facilitate farmer-sportsmen relationships. A new phase of the project is concerned with evaluation of the effects of the licensed game bird club system on pheasant hunting. Studies already have indicated that where habitat is suitable, planting of game farm birds shows small return in the matter of total increase.

2. Quail. A general evaluation of the effects of past development work on quail is under way in order to provide basic data for future developments. This is concerned mainly with the water development or "guzzler" program. Quail have thrived in areas formerly without water as a result of this program.

3. Chukar partridge. The initial phase of this study was a state-wide survey of chukar populations. An immediate result of this investigation was the determination that enough chukars are now present to call California's first chukar season for 1954. Continued investigations into the possibility of further expansion of chukars into suitable range not now occupied by the birds is being made. Wild birds trapped from established populations supplemented by game farm birds are used for stocking new areas. Other phases of the work involve nesting studies, brood counts, developing more efficient trapping methods, and food habits.

4. Band-tailed pigeons. A detailed state-wide study of the life history of the band-tailed pigeon is being made with special emphasis given to setting seasons, bag limits, and agricultural depredation problems. The department has been very successful in trapping and banding this species. Band returns show an intensive migration with interstate movements between the three Pacific states.

### Other Pittman-Robertson Projects

Other Pittman-Robertson federal aid in wildlife restoration projects in force during the biennium included maintenance, land acquisition and coordination projects.

Generally, development and management projects were carried out on a regional basis, while survey, investigation and coordination projects were the function of the central office staff.

Project W37-M provides for inspection and maintenance of quail guzzlers constructed under Project W26-D. Four land acquisition projects, initiated during the decade 1940-1950, provide for a small amount of money to add to any of the following areas should the need arise and land be available.

Project W10-L, Tehama Winter Deer Range—42,-897 acres acquired.

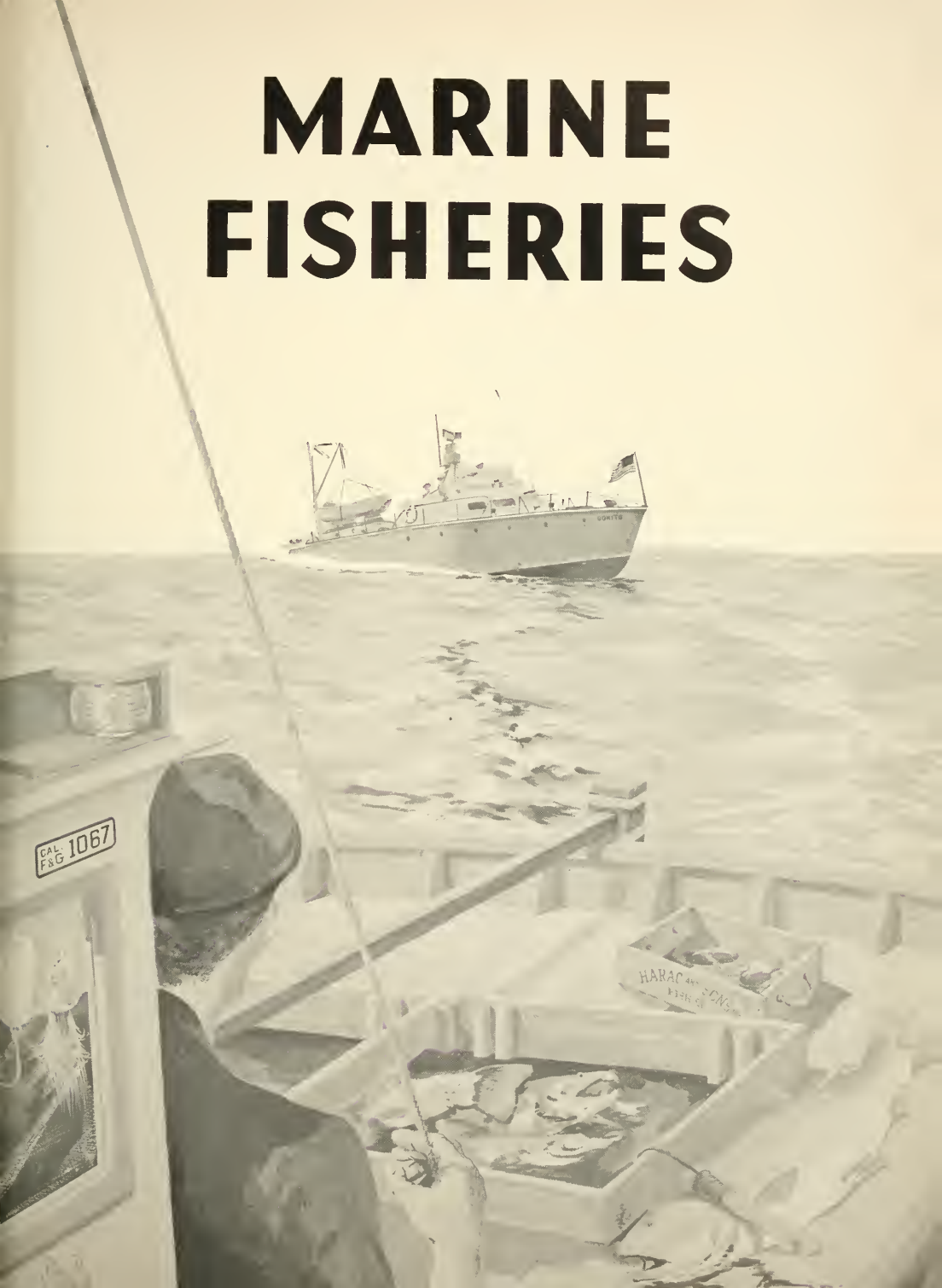
Project W11-L, Honey Lake Waterfowl Management Area—4,820 acres acquired.

Project W17-L, Madeline Plains Waterfowl Management Area—5,176 acres acquired.

Project W21-L, Doyle Winter Deer Range—13,503 acres acquired.

A final project, W29-C, wildlife management coordination, provides general direction and coordination by the central staff on all Pittman-Robertson projects.

# MARINE FISHERIES



*Sardines industry nears disaster during biennium.*

*Salt water sport fishery shows slight decline, although salmon sport fishery grows rapidly.*

*New oyster fishery established.*

*Fish screens and ladders program coordinated.*

*Anchovy canning replaces sardine packing to some extent.*

## MARINE FISHERIES

As additional demands are placed on California's oceanic and inshore salt water natural resources, the value of more factual knowledge concerning them becomes increasingly important. A mushrooming population, greater pressures for recreation and use of ocean products for food and industry all have had their effect on the sea and its inhabitants.

The Marine Fisheries Branch is concerned with the conservation of these resources. Many diverse and important commercial and sport fish activities are under the administration and study by the branch, and through constant contact with the complex ocean fishery, the branch recommends conservation and management practices.

The branch conducts investigations on the important segments of marine fauna with tunas, salmons, sardines, sport fishes, bottom fishes, oysters, abalones, and other shellfishes of major concern. Work is directed from headquarters through the field laboratories located at Terminal Island and Stanford. Fisheries investigations centered in the Southern California region are under the Terminal Island Laboratory as is the statistical operation. Fisheries studies of Central and Northern California are directed by the Branch Laboratory located at Stanford University, with accessory facilities for investigations located at Pacific Grove and Eureka.

The collection and processing of fish landing records is one of the most important phases of marine management, as only through the collection of these basic records can knowledge of what is happening to the fishery be obtained. This phase of the branch work is the keystone upon which understanding of the entire marine resources is based.

### DECREASING SARDINE FISHERY

In spite of danger signs over the years, repeated warnings from the Department of Fish and Game, and requests by the commission and the department for regulation and management of the fishery, all of which went unheeded, near collapse came in 1953 to the California sardine industry. During each of the past two seasons scarcely 5,000 tons were taken, a total equivalent to only an average day's fishing for any of the State's major ports during their heyday.

Causes of this catastrophe, resulting in heavy financial loss to the fishermen, the failure of many processing plants and a general economic disturbance in the whole industry, are twofold; heavy mortality among the older sardines, and failure in recruitment of young fish to the population.

Sardines in fishable numbers were not to be found on the California grounds. The only fisheries extant at the close of the biennium were those operating out of the Baja California ports of Ensenada and Cedros Island. Sardines from these Mexican waters have moved to the California grounds in former years and fishermen optimistically hope that they will do so again. Surveys by the department, continued during the past two years show, however, that there are not enough fish in these southern waters to support a fishery of the magnitude needed for a healthy California industry. As a consequence, when and if Mexican sardines should move north they could not bring about a complete restoration of the sagging fishery.

#### Much Below Average

During the 35 years in which studies have been made on sardine populations, survival from each season's spawning has varied markedly. Outstanding contribution of young fish to the population and to the fishery occurred every two, three or four years. Since 1939, no group of young fish exceeded average abundance and several were much below average, notably sardines resulting from the 1944, 1945, 1949, 1950, 1951, 1952, and 1953 spawnings. Thus for 7 of the last 15 years nature has not restored to the population the numbers which have been lost through man's activities and through natural causes.

Explaining the lack of sardines on the California fishing grounds, nature's failure to provide new recruits to the population, and the part man has played in bringing about this lack, is the task of the Marine Fisheries Branch and of the other agencies working in a cooperative investigation of the sardine and its environment.

The Marine Fisheries Branch has continued its assessment of sardine population abundance in Baja California as well as in California waters. Cruises in the last half of 1952 showed a scarcity of all such fish off California and no increase off the Mexican coast. Young fish resulting from the 1952 spawning were more numerous than in 1949, 1950, and 1951, but were not found in great numbers. In 1953 sardines again were very scarce off California, nor were there any indications of good survival of the young from the 1953 spawning. *An additional disturbing factor is the almost complete absence of spawning on the offshore grounds in Southern California, which in former years were the major source of new recruits to the California population.*

Studies of size and age composition of fish in the cannery catch have been continued in cooperation with the U. S. Fish and Wildlife Service. In both seasons of the biennium the remnant fishery depended chiefly on sardines four to eight years old and spawned prior to 1949. In 1952-53 these older fishes

comprised 85 percent of the catch, and in 1953-54 one-half. Mature fish which did appear off California were caught wherever possible before the spawning seasons. This reflects nature's failure to restore to the population new recruits in sufficient numbers to maintain a healthy fishery.

### Explanations Sought

Explanations of why survival from each season's spawning has been poor in the last five years, why there is practically no spawning on the Southern California grounds, and why there has been little apparent movement of sardines from Mexican to California waters, is being sought by all the agencies working under the direction of the Marine Research Committee.

Either one of two conclusions or a combination of both appears inescapable; that there has been an unprecedented series of years of unfavorable oceanic conditions, or that the sardine breeding stock has been heavily impaired by past heavy catches.

Because the part man has played in the serious reduction of the species is the only factor which can be controlled, the Department of Fish and Game is deeply concerned with the human phase of the fishery. It has regularly, but unsuccessfully, recommended regulation of the sardine fishery. Although the importance man has played in the fishery still is a matter of dispute in some quarters, the department feels strongly that the sardine resource cannot wait until all the facts are available, and that commercial extinction of the species is likely unless action is taken.

Failure of the industry has been so complete that the danger of continued overfishing cannot be ignored either by responsible agencies or by the citizens of California. Accordingly, the department, after consultation with leaders of the industry and with sportsmen's organizations, presented to the 1953 Session of the Legislature a management plan designed to restore the sardine industry as well as that of the Pacific mackerel, and to maintain the anchovy and jack mackerel fisheries. The plan, which would have authorized seasonal catch limits to be set by the Fish and Game Commission on the basis of abundance of the various species, was not adopted. Thus the industry, not entirely ready to accept conservation measures, continues to operate on a day-to-day basis, unregulated, and fast fading into memories of what was, and what might have been.

*Sardine eggs being artificially fertilized abaard the research vessel Yellowfin. The larval fish are kept alive far several days far research purpases.*

## SPORT FISHING

Although the California off-shore sport fishing catch declined considerably during the biennium, the salt water angler still can choose a fishing boat from a fleet of 1,000, and he can find a sport boat landing in every major California port and most of the minor ones.

Fishing accommodations range from small commercial craft with room for one or two anglers to luxurious boats with staterooms and galley service available. Most of the sport fishing fleet is concentrated in Southern California waters and the greatest catch is made there. In addition, there is an almost equal fishing effort from private boats and piers.

Private ownership of skiffs and small boats is increasing rapidly and may be contributing to an apparent stabilization of growth in the sport boat fleet. In 1953 sport boats reported a reduction of 70,000 passenger days from the 1952 figure of 563,000 passenger days. At least part of this reduction can be traced to poorer fishing. Following is a table showing comparative commercial sport boat catches of the three most important game fish species:

| | Numbers of Fish | | |
|---|---|---|---|
| *Year* | *Albacore* | *Yellowtail* | *White seabass* |
| 1952 | 187,000 | 59,000 | 41,000 |
| 1953 | 23,000 | 26,000 | 28,000 |

Offsetting these decreases, jack mackerel were taken by Southern California sports fishermen in great numbers, 195,000 in 1953 as compared to 4,500 during the previous year. This created fishing for thousands of anglers, and marked the first instance that these fish assumed any importance in the sport fishery.

### Removed From List

An important development during the biennium was the removal of the kelp bass, a highly important game fish, from the commercial fish list by the 1953 State Legislative Session. At the same time a minimum size limit of 10½ inches was imposed. Both moves, based on research facts, were widely endorsed by the sports fishing industry and contributed directly to sound conservation of this fishing.

Tagging and life history work with the kelp bass was continued, with more than 3,000 fish tagged during the two-year period. An important development was the use of monofilament nylon, which was found to be superior to stainless steel or silver for tagging certain kinds of sports and commercial fishes, and

which has been used exclusively since 1953. Three hundred kelp bass were transplanted from San Clemente Island to Santa Catalina Island in November, 1953. More than a quarter of these fish were recovered at the latter area, with no recoveries from the transplanted group at San Clemente Island.

An experiment, conducted beginning in September, 1953, on removal of starfish from the outer breakwater of Los Angeles harbor, revealed several beneficial developments. Twelve tons of starfish were removed with the aid of more than 200 skin divers. The fish were found to yield a meal product of some value, and could possibly form the basis of a new fishery. Later observations in the area indicated among other benefits a heavy survival of young mussels.

Development of underwater breathing apparatus, for observation of fish in their native environment, has contributed much basic knowledge and facts about the life history of sports fish.

## LIVE BAIT FISHERY

As pressures in marine sport fishing continue to grow, the demand for live bait increases correspondingly, especially in Southern California. Boats devoted almost exclusively to supplying this bait have met the increased demand not by expanding in numbers but through increased efficiency. During the past two years at least 10 new boats have replaced older craft.

In the sheltered waters of Los Angeles-Long Beach Harbor, lights suspended from skiffs and powered by gasoline generators are anchored at nightfall. When sufficient fish, measured by the use of echo sounders, have collected under these lights a bait net is set around the school, pulled by a power gurdy, and the bait tanks and receivers filled. Thus a steady supply of bait is available to the party boats of Los Angeles Harbor and vicinity which leave for the fishing grounds at or before dawn.

Prior to these innovations the bait fishermen located the fish visually about daybreak, and pulled the nets by hand. Many times the party boats had to wait for bait and could not leave for the fishing grounds until long after daylight.

### Operate in North

Until 1952 the live bait fishery was confined to the waters south of Ventura. Then with the expanded use of live bait on the sport fishing boats of Santa Barbara and northward, a fishery developed to meet the new demand. Now live bait fishermen are operating as far north as Morro Bay.

Anchovies always have been the mainstay of the live bait fishery, but prior to the catastrophic disappearance of the sardine, 15 to 20 percent of the bait consisted of sardines. In 1952 less than 2 percent of the catch was made up of this species and in 1953 less than 1 percent. Other species, such as white croaker, kingfish, queen-

*Some of the electronically equipped bait vessels of the Bait Haulers' Co-op in Los Angeles Harbor.*

fish and smelt, occur in the fishery, but anchovies continue to dominate the catch. In 1952 and 1953 it comprised 95 percent of the take and during the past seven years has supplied over 80 percent. The anchovy population in Southern California waters has so far been able to supply a demand that has increased almost two-fold in seven years.

## THE TUNA PICTURE

Growth was the dominant characteristic of the tuna industry during the biennium. Signs of this growth were evident in all segments of the industry throughout the period. An important milestone was the opening of the world's largest tuna processing plant at Terminal Island, Los Angeles Harbor, in November, 1952. This plant has operated continuously since its dedication. To keep pace, other companies modernized their plants or regrouped for strength.

Perhaps the growth of the industry is best reflected in the statistics of the period. A new high in production was attained in 1953 and preliminary figures for the first six months of 1954 indicate that the case pack is 22 percent above the like period of 1953. The California fleet contributed the major portion of the raw product but importations grew steadily in volume with no signs of a let-up at the biennium's close.

The price of raw fish, further exemplifying growth, increased from $320 to $350 per ton for yellowfin, from $350 to $400 for albacore, from $310 to $350 for bluefin, and from $260 to $310 for skipjack. In each instance the latter price was being paid at the end of the biennium.

### Potential Not Realized

This growth of the tuna industry followed the U. S. Government's decision not to increase the tariff or import duties on raw or processed fish. In some quar-

*Scale samples being taken during yellowtail tagging operations off Guadalupe Island, Baja California.*

ters this decision was regarded with gloom, but the industry, engrossed in its own expansion, apparently underrated its potential.

The fleet operated at near capacity throughout the biennium. The brief layover shortly after the period's beginning was the one exception. Various members of the fleet engaged in exploration for new fishing grounds and experimented with gear new to the tuna fishery of the Eastern Pacific. Vessel loss was materially reduced over the preceding biennium.

In two instances old reliable fishing grounds failed to yield as in the past. The failure of the equatorial fishing grounds off Central and South America in the winter and spring of 1952-53 is associated with the phenomenon known as "El Niño" (a change in ocean currents caused by weather conditions), which is a complete reversal of usual meteorological and oceanographic conditions. On the other hand, there is no ready explanation for the poor fishing experienced by the purse seine fleet in the Gulf of California in the spring of 1954. Compensating for these failures was the discovery of a new fishing bank off southern Peru, representing a southern extension of the South American fishing grounds.

Experiments with new gear and fishing aids included design of a rapid-closing purse seine net; use of suction pumps for speed in transferring bait aboard bait boats; trials with Japanese long-line gear for subsurface fish in established fishing grounds as well as in new areas; and the use of new electronic devices such as fish scanar, fishlupe, etc., which enable the fisherman to find and follow subsurface schools of fish.

Tuna research forged ahead during the biennium, using available resources to the fullest to meet the challenge of a growing industry. A full scale tagging program was inaugurated to study the migratory patterns and rate of growth of yellowfin tuna, skipjack and albacore. Results have been spectacular. The trans-Pacific migration of albacore was revealed when an albacore, tagged off Santa Catalina Island, was recovered 324 days later 500 miles southwest of Tokyo, Japan. Two tagged albacore, released off Guadalupe Island, Mexico, in August, 1953, were recovered in February, 1954, near Midway Island, in the mid-Pacific Ocean, by Japanese long-line fishermen. The growth potential of yellowfin tuna was demonstrated with the recovery of a tagged fish at liberty for one year, which had gained 25 pounds.

### Picture Not Complete

While some of the recoveries have been outstanding in themselves, the over-all recovery rate is insufficient as yet to give a complete picture of the migrational patterns of the various species. In an attempt to increase the returns, the tagging program was expanded greatly near the close of the biennium.

The program of exploratory fishing and gear development was channeled toward the search for subsurface stocks of tuna and the whereabouts of albacore in the off season. The M. V. *N. B. Scofield* carried on exploration in the equatorial waters off Central and South America in cooperation with the Inter-American Tropical Tuna Commission and Scripps Institution of Oceanography. A complete report was being prepared for publication at the close of the biennium.

The search for albacore with the M. V. *N. B. Scofield* in the off season (fall, winter and spring) demonstrated that these fish are not off our coast during the winter and early spring months.

The studies on age and rate of growth of yellowfin, skipjack, albacore and bluefin were continued throughout the biennium. Analysis of the skipjack and albacore length frequencies were started toward the end of the period, with presentation anticipated in the near future.

## SALMON

Sport fishing for salmon in the ocean off California has developed into big business within the past 10 years, and, according to estimates based on tagging and sampling programs, rivals the commercial catch not only in numbers of fish taken, but in economic value to the State as well. The fishery is estimated to be worth $8,000,000 annually.

Salmon landings made by commercial fishermen in California's ocean and river fisheries averaged 7.6 million pounds during 1952 and 1953, representing an increase of about 250,000 pounds per year over landings of the previous two-year period.

The increase was entirely due to ocean troll landings which averaged 6.8 million pounds during the past two calendar years. Decreases of about 240,000 pounds

were shown in the Sacramento-San Joaquin River gill net fishery landings during the period of the report, as compared to the years 1950 and 1951. Curtailment of the area open to gill netting, imposed by the State Legislature, was responsible for the smaller landings. Restrictions created by the law affected an entire season for the first time in 1952.

At the same time shipments of salmon into California by common carrier averaged 770,000 pounds per year during 1952 and 1953, a decrease of 140,000 pounds under the two previous years. Most of the shipments are bound for Los Angeles.

### Sport Fishing Study

Because of the ever-increasing pressure on the salmon population by the new sport fishery, it became apparent that more factual knowledge of its methods, catch composition, and economic as well as recreational value would be required to assure proper management regulations, thus assuring safeguards for future abundance of the salmon resource on which it depends.

Plans formulated and approved in 1953 for a federal aid project will supply the necessary minimum investigation of California's ocean salmon sport fishery.

### Marking and Mark Recovery

In 1950 an interstate salmon marking program was started on the recommendation of the Pacific Marine Fisheries Commission to determine, among other things, the contributions made to the ocean fishery in different areas by salmon originating in various river systems of the Pacific Coast. The actual marking was described in the last biennial report.

An obvious corollary to a marking experiment is a carefully planned mark recovery program. California, in cooperation with Oregon, Washington, British Columbia, and Alaska, has such a recovery program. Men stationed at coastal ports from Monterey, California, to Pelican, Alaska, search for marked fish in the catches landed by ocean salmon trollers. This program is coordinated by the Pacific Marine Fisheries Commission with which British Columbia and Alaska voluntarily cooperate. Activities of this commission are more fully discussed in another section of this report.

Pertinent data is summarized regarding each marking experiment made by the department since 1950 in the table entitled "Salmon Marking and Recovery," Appendix Table 40. Marking experiments conducted by Oregon and Washington are not included; recoveries of California marks made by them, as well as by British Columbia, are included for 1952 and 1953. No California marks have been recovered off Alaska to date.

A word of explanation is necessary in regard to the higher survival rate of hatchery fish as compared to wild captured fish in the release of 1949 brood year king salmon in the Sacramento River.

Because of difficulties in capturing wild salmon fingerlings without injury, only "cull" fish were taken. Fish hatched at Coleman Station, a salmon hatchery operated by the U. S. Fish and Wildlife Service, were bigger and in better condition than the wild fish when released.

Results of the experiments to date show that in 1952 the 1949 brood year king salmon from the Sacramento River were taken in greater numbers by the combined ocean troll fisheries of Oregon, Washington, and British Columbia than by the California fishery. Final analyses will demonstrate whether or not this happened again in 1953. Conversely, the majority of silver salmon taken by the California fishery originated in Oregon's coastal streams. Hence, when something changes the salmon producing potential in one state, the economy of other states will be affected.

*Part of the California salmon fleet anchored at Point Reyes, where as many as 300 boats sometimes anchor during the run.*

Demonstration of this one fact alone would be enough to make these marking experiments a success; however, a great deal of additional data is being collected, the analysis of which may well prove to be of even greater value to proper management of this renewable resource.

### King Salmon, Ocean Tagging

During the 1952 season, 1,318 king salmon were tagged, all off San Francisco from boats furnished by the Golden Gate Sportfishers Association. The cooperation of this association of party boat operators not only saved the State several thousand dollars, but assured a good catch of fish and produces a better sample of the fish taken by the sports fleet than could have been obtained by any other method. The San Francisco Tyee Club, a group of sportsmen organized for the purpose of conserving the salmon, has contributed to our program by posting over $1,000 for the return of certain lucky salmon tags. These bonuses have been a great help in assuring the return of tags.

Returns of king salmon during the biennium which were tagged in 1952 are shown in the table by the area of recapture. The figures reflect the fact that most king salmon are now taken in the ocean and that nearly all the salmon taken off San Francisco come from the Sacramento-San Joaquin River system.

The principal purpose of this cooperative program is to determine the best size limits for the ocean salmon fisheries.

### Catch Sampling

In addition to obtaining reliable figures on the proportion of marked fish in the ocean catch, the department's samplers are getting valuable information for detailed analyses of the fishery and the two species of salmon supporting it. A summary of fish examined during the ocean catch sampling program is presented below:

| | *1952* | | *1953* | |
|---|---|---|---|---|
| | *King* | *Silver* | *King* | *Silver* |
| Number examined | 63,361 | 9,111 | 165,346 | 25,628 |
| Percent of catch sampled | 12.8% | | 33.3% | |
| Average weight | 12.2 lbs. | 8.2 lbs. | 12.8 lbs. | 7.9 lbs. |
| Percent of catch by weight | 88.5% | 11.5% | 91.6% | 8.4% |

Additional material collected has included random length measurements, scale samples and lengths for age analyses, sexual maturity data, and data regarding weather and prices and their effect on fishing effort.

An unusually large number of pink or humpback salmon were taken off California as far south as San Francisco during July, 1953. Based on sampling data, it is estimated that about 700 were landed. This is the first time in recent history that this salmon has appeared in such large numbers in the California fishery.

In conjunction with ocean catch sampling, Marine Fisheries Branch personnel sample the catch of the gill net fishery operating in the Sacramento-San Joaquin River delta. Marks recovered here serve as a valuable check on ocean recoveries.

Sacramento-San Joaquin River Delta King Salmon

| | *1952* | *1953* |
|---|---|---|
| Number examined | 10,391 | 17,192 |
| Percent of catch sampled | 27.4% | 43.7% |
| Average weights | 19.5 lbs. | 20.3 lbs. |

### Spawning Area Surveys

Annual inventory of the spawning populations utilizing the spawning areas in California's rivers is made each fall and winter. During their survey trips crews examine thousands of salmon that have died after spawning, and while examining these carcasses find many marked or tagged fish. The data collected on these surveys completes the cycle in the search for facts upon which to base wise salmon management regulations.

An important demonstration of the homing instinct in silver salmon was demonstrated by mark recoveries on the north coast in 1953. Early in 1951, more than 16,000 marked silver fry were released into Lindsey Creek, the only one of several small tributaries to the Mad River that received marked fish. Because silvers spawn and die at the end of their third year, survey crews expected and found them back in the winter of 1953.

During the fall of 1953, survey crews participated in redevelopment of a salmon population in Clear Creek, a tributary to the upper Sacramento River. This stream once had a run of king salmon that spawned above the site of a dam which since construction has barred its passage for years. The dam is

*Department crews checking the commercial salmon catch for fin marks. Measurements are taken at the same time.*

at the head of a steep gorge and the problem of getting fish by both gorge and dam was a difficult one.

Establishment of a run by transplanting ripe adults into such a stream was attempted. In cooperation with the U. S. Fish and Wildlife Service's Coleman Station personnel, 1,428 adult king salmon were trapped at Keswick Dam on the Sacramento River, and released in Clear Creek above the dam.

Survey crews observed later, and some were captured for identification. Complete results of this experiment will not be available until after 1957, when most of the fish that are going to return will have done so. By the time the fish return, the department plans to have an adequate fish ladder completed through the gorge and over the dam.

## JACK MACKEREL

The meteoric rise of the jack mackerel fishery in 1947 was attributable in a large part to the almost complete failure of the sardine fishery and the diminishing Pacific mackerel landings. A second important factor was the increased use of depth-sounding devices for locating schools of fish not visible at the surface.

After seven years of fairly heavy fishing effort the fishery is now confined almost exclusively to Southern California because the jack mackerel have disappeared from other waters. During the years 1947 to 1950, Monterey was a fairly important port of landing but since 1950 the contribution from that area has been of little significance. The catch since 1947 has fluctuated almost yearly with little correlation to observed conditions.

Preliminary age work completed during the biennium indicates the commercial fishery is largely dependent upon fish ranging from one to four years of age. Fish of this age vary in size from about five to 14 inches. Each year, however, several purse seine loads of very large jack mackerel are taken and these fish, ranging in length from 20 to 25 inches, appear to be from 10 to 20 or 25 years old. These very large jack mackerel have become an important constituent in the Southern California sportfisherman's bag during late spring and early summer of the past two years.

## THE ANCHOVY FISHERY

Scientists, commercial fishermen and sportsmen have been keeping a close watch and are feeling some degree of alarm over the diminishing stock of anchovies off the California coast. This feeling reached a climax after the 1952 season of heavy pressure off Central California when the anchovy stocks reached a point of diminishing return to the fishermen, and there were not enough large schools of the species to make fishing profitable on a steady basis. Since the summer of 1953 all anchovies processed in Central California packing plants have been trucked from Southern California due to the lack of the once abundant stocks nearby.

*The Porter seine, a new type of net used in daytime airplane fishing, is highly efficient for catching anchovies, sardines and jack mackerel. Wings of the net are being hauled over the stern with vertical power gurdies.*

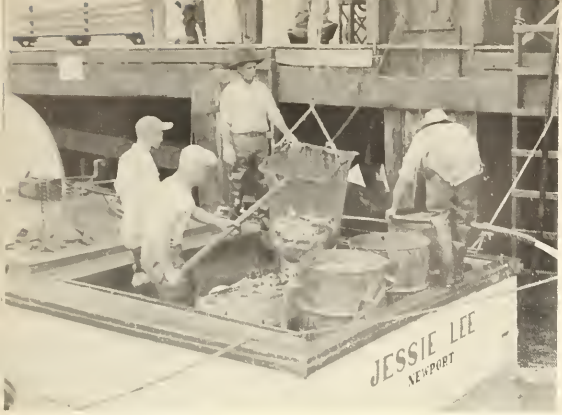
For years the anchovy has been of importance in the commercial and bait fisheries of California. From 1916 to 1946 most of the catch was used for bait purposes—for live bait in the Southern California sport fishery, for salted dead bait in both the sport fishery and in the albacore fishery, and for use as ground chum by the Pacific mackerel scoop fishermen.

During the period from 1916 to 1946 only small amounts of anchovies were used for food and for reduction. In 1921 teeth were put into a law prohibiting the use of anchovies for reduction purposes. It was felt that such protection was needed to safeguard the stocks of this species, both because of its importance commercially and because of its importance as a forage fish for sport and commercially important predatory species.

### Experimental Packs Made

From 1946 on, with the advent of the drastic decrease in sizes of the sardine and Pacific mackerel stocks along the Pacific Coast, there arose the immediate need for packs of other species to supply domestic and foreign markets. Inasmuch as anchovy stocks appeared large enough and could be taken with current sardine fishing methods many experimental packs were made. They met with serious domestic sales resistance but the anchovy "sardine style" pack in tomato sauce met with favorable response in several Asiatic and South American countries. The industry then centered its activities in processing styles that would sell readily on the export market.

Coincident with the development of anchovy canning, the use of fishery products for pet foods expanded rapidly. Jack mackerel was the main constitu-




*Pacific mackerel being bailed from scoop boat to conveyor belt at a Newport Beach cannery. Note barrels of chum at the stern.*

ent of these packs but in 1953 a ready supply of this species was not available. This resulted in the increased use of anchovies for pet food. Thus, the anchovy today is the primary species used in the bait and chum fisheries of the State, in the export market of "sardine style" packs, and supplies an important part of the fishes used in pet food.

Rapid development of the anchovy fishery is shown clearly in the catch figures. Since 1945, the year before canning of anchovies was started, the catch has increased from about two million pounds to about 100 million (including both commercial and live bait) in 1953. Total catch figures prior to 1948 do not include estimates of the poundage of anchovies taken for live bait purposes. Since 1948 in some years the take of anchovies for live bait has been more than the take for commercial purposes.

### Efficient Methods

With the development of the anchovy fishery there has developed revolutionary and highly efficient methods of capture and processing. The anchovy is a delicately textured fish and care must be taken to make the pack presentable and to meet the stiff case pack requirements put into effect in 1948 by the then Division of Fish and Game.

A new style lampara net called the Porter seine (named after one of the principal inventors of the net) was developed in order to more efficiently work in the daytime in cooperation with aerial observers who direct the actions of the boat in catching the fish. This method of "airplane fishing" has been developed to its highest efficiency in the Port Hueneme-Santa Barbara area of Southern California, where the bulk of the high catch of 1953 was made. The now limited amount of anchovy fishing in Central California still is being conducted by the boats using purse seines and Monterey-style lampara nets. Fishing in this area still is carried on at night, for daytime airplane fishing is impractical in the Central California area due to frequent periods of foggy weather.

Possibility of a future stable market for anchovy products is good if the stocks of anchovies hold up under the present fishing pressure.

Investigations of the department are aimed at obtaining facts on which management of the species can be based, and to inform the people of conditions in this important fishery. These investigations already have shown that the anchovy, a valuable forage fish, should be kept at high levels of abundance to provide feed for larger fish and bait for commercial and sports fishing.

## PACIFIC MACKEREL

While the attention of the Pacific Coast fishing industry focused on the spectacular failure of the California sardine, a similar decline in the Pacific mackerel fishery, although not unnoticed, failed to cause any great alarm.

In spite of increased fishing intensity, the catch of Pacific mackerel in the 1952-53 season dropped to the lowest total in 20 seasons. Continued heavy fishing pressure during the 1953-54 season resulted in only one-third of the poor catch of the previous season and a new record low during 26 seasons. Not since 1928, when the Pacific mackerel first became prominent as a cannery species, had the yield from California waters been less than 10,000,000 pounds.

A successful fishing season becomes more and more dependent upon incoming year classes. This is vividly illustrated by the fact that for five seasons, 1948-49 through 1952-53, two year classes (1947 and 1948) alone contributed more than 75 percent of the fish caught. During two of these seasons these two year classes made up more than 90 percent and during two others over 85 percent of the total catch. By the 1953-54 season these year classes had been almost completely exhausted (contributing but 5 percent). They were replaced in importance by the mackerel hatched in 1953, which before they were one year of age had yielded over 80 percent of the season's catch.

### Shift Is Reflected

This shift in percentage from old to young fish is especially reflected in the poundage yield. During both the 1952-53 and 1953-54 seasons nearly an identical number of fish were taken (14,200,000 and 14,800,000). However, in 1952-53 the fish five and six years of age (85 percent in numbers) made up 89 percent of the total poundage. On the other hand the 1953 year class which made up 82 percent of the 14,800,000 Pacific mackerel caught during 1953-54 actually comprised but 57 percent of the 7.6 million pounds.

Routine sampling of the commercial catch continued whenever fish were available, and from this sampling much of the basic information for the numerous biological studies is acquired.

The department recommended a management plan for mackerel along with sardines to the 1953 Legislature, but it did not receive favorable consideration.

## NEW CLAM FISHERY

Possibility of a new clam fishery in Morro Bay has developed as a result of the 1953 transplanting of Japanese littleneck clams from San Francisco Bay to Southern California waters. Because of harbor dredging as well as clam digging, the various species of littleneck clams became quite scarce in Southern California bays, and the department planted 6,000 of the Japanese littlenecks, 4,000 at Morro Bay and the remainder at Newport Harbor.

At least half of those planted at Morro Bay lived and showed remarkable growth during their first year. From all appearances these should spawn during 1954, and if successful there may soon be a new fishery where none existed before. Clams planted in Newport Harbor were placed in deeper water and no observations on their progress have been possible.

Pismo clam censuses conducted at Pismo Beach and Morro Bay during 1951 and 1952 indicated a continuing shortage of young clams at both locations, apparently the result of very poor sets during the past several seasons. However, the number of legal clams in closed areas or clam sanctuaries has increased considerably each year, showing that short-term closures do assist materially in building up a supply of legal-sized clams. Information of the 1952 and 1953 censuses was published in April of 1953.

### Clam Mortality Investigated

Department biologists investigated reports of an alleged set of Pismo clams in Morro Bay, the young of which were supposedly dying. People of the area were considering transplanting them to a more favorable habitat, a project involving tremendous expense. Department biologists determined that the "baby Pismo" clams were not Pismo clams at all, but a variety having no common name, and which never attains a size greater than a quarter of an inch, and which never lives more than one year.

During the fall and winter of 1953-1954 the laboratory was asked to identify a species of clams which was blocking irrigation pipelines in the Imperial and Coachella Valleys, and was incurring considerable expense to farmers. This was found to be the same species of fresh water clam, *Corbicula fluminea*, which had become established in the Sacramento-San Joaquin drainage within the past decade. An oriental species, its introduction into California can only be surmised. Its spread is best attributable to the army of small boat-owning fishermen and hunters traveling from one river system to another with bait buckets and bailing cans unknowingly filled with the microscopic larvae of this prolific clam.

## THE ABALONE FISHERY

Although the commercial abalone catch dropped slightly from the previous biennium it still remained above 4.7 million pounds. Among the highlights of the period was the emergence of developments in the diving field, both with conventional gear and with the aqua-lung. These developments played an important part both in the commercial catch and in investigations being conducted by the Branch of Marine Fisheries.

In Southern California, where the industry is concentrated in the Channel Islands, some of the commercial divers were forced to descend well over 100 feet to reach abalones of sufficient size and abundance. An interesting development as a result of this deep diving has been the appearance of a new species of abalone in the catches. So uncommon is this abalone that it has not been definitely classified.

The abalone investigation has continued operations during the biennium with the major area of effort concentrated along the north coast. Since the greatest single problem is to determine how the population of abalones in the intertidal zone is replenished, principal efforts have been directed along this line. The tagging program, which was an attempt to approach this problem, is being continued.

### Survey North Coast

A setback suffered by the investigation was the loss of the mother ship, *Broadbill*. This vessel sank during a storm while tied to the dock. She was refloated but had suffered considerable damage, and will be replaced with a larger and more seaworthy vessel. The department has purchased the *Nautilus*, a former 50-foot northern drag fishing boat which is being modified for adaption to the needs of marine research. When

*The diving boat Mollusk, used in the department's abalone investigations. Bottles in foreground are used to re-fill aqua-lung tanks.*

*A young market crab, ⅞ of an inch in width. At this stage the young crabs are an important segment of the crab investigations.*

this vessel is placed in commission, it will then be possible to continue the survey of the north coast in an effort to evaluate the potential abalone resources of the area.

In an attempt to assess the take of abalones by sportsmen, a check system was set up whereby an actual count is made of the number of sportsmen fishing for abalones at a representative locality during periods of low tides.

Since abalones inhabit the rocky shores from the zone of high tide out to well over 200 feet, it is necessary that the research team be qualified to dive. In addition to the regular commercial type diving gear, members qualified for the first time during the biennium in use of the aqua-lung, having attended the U. S. Navy's Diving School at the San Francisco Naval shipyard where they received instruction in the use of equipment used by the Navy's "Frogmen." The frog-man type of equipment is especially valuable in making exploratory dives and underwater surveys. Since the diver does not have to clamber up and over rugged terrain, he can swim above such obstructions and observe a wider field than the diver using conventional gear. However, for tagging and several other phases of the work, the use of commercial suit and equipment has been found to be more desirable.

Although sufficient evidence for conclusive proof was unavailable at the close of the biennium, several general statements can be made concerning the findings of the investigation.

Along the north coast where activities have been conducted, the total population of abalones has been found to be less than was at first suspected. In addition, the greater number of these abalones are of small size (i.e., less than 7¾ inches). There are locations in which the general size appears to be larger than this, but these are not common. Preliminary investigations on the quality of the meat have been made and it has been found that the majority of abalones obtained by diving have a dark meat. The ocean bottom along this area presents a rough and rugged terrain, dominated by huge boulders, chasms, and rugged, rocky cliffs. Especially disconcerting has been the scarcity of weather suitable for diving. An average of perhaps three to four diving days per month during spring and summer was typical.

## MARKET CRABS

Landings of market crabs, while subjected to a considerable increase in fishing pressure for the past several years, showed an abrupt drop from the high of 13,000,000 pounds in 1952, but still well above the 30-year average ending in 1945.

In the San Francisco area the market crab fishery showed annual landings of 4,000,000 pounds for the past five years while the Eureka area brought in double the poundage of the Central California fishery. The drop from the 1952 high to about 8,000,000 pounds in 1953 was due to a decrease in the north coast landings as shown in the graph (Table 51, Appendix). Since a rather complete harvesting of available legal size crabs occurs each year, the drop may be due to a poor year class. It is also possible that this may be an indication that the fishery of Northern California will level off at considerably lower annual landings than the high peaks of recent years.

Intensive fishing with crab traps is accomplishing an intensive harvesting of the available marketable crabs during the first few months of the crabbing season. At San Francisco 83 percent of the crabs landed in the 1952-53 nine-month season were brought in during the first three months of the season. The trend is the same in Eureka where from 50 to 60 percent of a total season's landings is accomplished in the first third of the season, compared to about 35 percent as recently as during the 1948-49 season.

Specially designed crab traps with circular escape openings are being demonstrated by the department to show the value of improved gear in allowing rapid escapement of undersized crabs while the trap is actively fishing on the ocean floor.

Study of the early life history of the market crabs in California waters was carried on to obtain data on the populations of crabs less than one year of age, since this supply of young will eventually replace the size groups thoroughly harvested by the crab fishing fleet. It is anticipated that the modern research vessel, the *Nautilus*, using specially designed gear, will make possible investigations of the crab fishery long desired but not heretofore possible.

## OYSTER PROGRAM

Unique in its outlook, the department's California oyster program is not confronted with over-exploitation of a resource, but in fostering establishment and growth of a valuable fishery in areas formerly nonproductive. With a firm oyster policy and with new regulations adopted in 1954 by the Fish and Game Commission to encourage full utilization of natural

conditions, indications point to greater production and possible re-establishment of oyster culture in California waters.

California oyster industry is aimed primarily toward production of the Pacific giant oyster, which has yielded far less during the postwar years than before hostilities. Importation of seed from Japan was cut off and the landings decreased accordingly. Expected increase in oystering activity after the war failed to materialize, because large acreages of oyster land were being held and not planted, although seed was then available. During the past biennium the more progressive oystermen have become active, augmented by new additions to the field.

Since 1952 the importation of larger shipments of oyster seed from Japan has resulted in the enlargement of oystering areas within California bays. Morro Bay operators have taken the lead in progressive oyster culture by the introduction of methods yielding greater landings per unit of area. The most modern and efficient oyster handling plant in California now is located there.

### Many Young Oysters

Oystering activity in Marin County has recently led to the construction of several small oyster houses to handle harvests from increased plantings. In Humboldt County test plantings by oystermen have shown such rapid growth that very complete allocation of available oyster lands has resulted. There are now young oysters in California waters in sufficient abundance to bring Pacific oyster production well toward the degree of opulence enjoyed during 1938-1941.

Consumer demand for oysters in San Francisco and Los Angeles represents the greatest in the West. These demands are far from being met and a still greater market is appearing for canned oyster meats and oyster stew, leading to production attempts on all potential oyster lands.

Experimental plantings have yielded Pacific oysters of marketable size within 11 months, a size normally attained in three to four years in Japan. A variety of oysters from Southern Japan was planted in several Central California bays and the Salton Sea. This particular oyster, which produces a small meat suitable for the cocktail market, grew very well and produced marketable oysters 18 months after planting in the marine waters of bays and the Imperial Valley as well.

Increased importations of Pacific oyster seed from Japan and of full-grown eastern oysters from New York have increased the possibility of infestations of oyster drilling snails. Loss of oysters attributed to oyster drills in other states amounts to millions of dollars each year. California law requires the inspection of all shellfish destined for planting in waters of the State. It was necessary to condemn 500 cases of Pacific oyster seed imported during the 1952-1953 season because of the presence of drills in the shipment.

## BOTTOM FISHERIES

### Trawl

The otter trawl fishery, leading producing unit in Northern California, has registered new highs in bottom fish production during the last biennium. Trawl landings have risen to over 30,000,000 pounds of fish per year in spite of stiff competition from low-priced foreign imports of fresh and frozen fillets. This increased trawl production, nearing the ultimate potential of the fishery, makes imperative adoption of additional constructive conservation measures to insure its future existence.

In the Northern California area 40 to 60 trawlers have fished each month, and in the Central California area the number fishing each month has increased from about 8 to 18. In the Central California area bottom fishing is undergoing a change from the historic long-line type of fishing gear to the use of the more efficient otter trawl.

Dover sole again leads in total poundage landed, with English sole and petrale sole following in importance.

For many years several species of rockfish, hake, skates, and rays were little utilized due to low market demand. This nonutilization has long been a problem in the trawl fishery, but it is being partially solved by the use of several of these species in mink food, cat and dog food, and the use of skates, rays, ratfish, and fillet offal in a new liquid fertilizer product. Several species of rockfish are now being used in a new fried, frozen fishstick product that has received nation-wide acceptance. With the development of these new markets and products, the practice of selective utilization is being reduced in this important segment of our State's marine resource.

### Conservation Method

One of the most practical methods of conservation in the trawl fisheries is to allow the escape of undersized and immature flatfish from the otter trawl net

*An oyster bed recently established in Morro Bay.*

while it is operating on the bottom. Various mesh sizes were checked for escapement of small flatfish during extensive mesh-testing experiments aboard the survey vessel, *N. B. Scofield*, in the fall of 1952, off the coasts of California, Oregon, and Washington. As a result of these experiments the Pacific Marine Fisheries Commission recommended that a 4½-inch minimum mesh regulation for otter trawl nets be adopted by the three Pacific Coast states.

The recommendation presented problems when applied to certain types of specialized trawl netting, such as "hog ring cod-ends" and "double cod-ends."

The practice of stapling together strips of manila line with metal hog ring clips to form webbing is a recent innovation in California. The webbing is used in the making of the cod-end or rear portion of the trawl net—therefore the term "hog ring cod-end." Double cod-ends are composed of two walls of webbing, making it essentially a cod-end within a cod-end, instead of the usual one wall of mesh webbing cod-end. Both types of webbing give greater strength and wear resistance, but due to their additional bulk and reduced flexibility, the size of the fish retained by the gear is smaller than that retained by the conventional single mesh cotton web cod-end.

These additional problems warranted joint action by the States of California, Oregon, and Washington through the auspices of the Pacific Marine Fisheries Commission, and steps were undertaken to solve them.

### Net Mesh Experiments

The survey vessel, *N. B. Scofield*, completed extensive mesh-testing experiments during the spring of 1954 during which time a comparison was made in size of fish retained between conventional single cotton web cod-end and the hog ring and double cod-end. Results of these tests are being analyzed and will be used as the basis for future regulations to protect immature fish.

*A beam trawl net, used in the bottom fishery loaded with shrimp.*

Extensive experimental commercial fishing gear development work has been conducted by the bottom fisheries staff during 1953. Development was begun on a new mid-water trawl and preliminary tests on this gear were made in 1953. This gear, which is similar to an otter trawl, opens fishing in the mid-depths of the ocean, an area heretofore not extensively fished.

The study of trawler boat logs was continued to enable the bottom fishery staff to follow the changing trends in species caught, location of fishing areas, and the poundages landed. This information will aid in the adoption of constructive trawl fishery legislation.

## NEW SHRIMP FISHERY

A new commercial shrimp fishery for California has been established since the 1950-1952 biennium. This new fishery is the result of exploratory work by the survey vessel, *N. B. Scofield*, in 1950, 1951, and 1953, during which time the quantity and extent of the shrimp beds off the California Coast were mapped. Shrimp beds were found off Pt. Buchon, Bodega Bay, Shelter Cove, and Pt. St. George in 1950 and 1951. In 1953 additional exploratory work revealed a southern extension of the Pt. Buchon bed, and small beds of shrimp were located off Gaviota and Santa Monica.

The first year of commercial ocean shrimp fishing (1952) saw 206,000 pounds landed in California, of which 198,000 pounds were caught off Pt. Buchon and processed at Morro Bay. Processing the product to its final cooked and peeled form provided employment for as many as 65 people in this area. Catches at Bodega Bay and Crescent City were only about 3,500 pounds each, due to extensive problems in fishing techniques.

The 1953 ocean shrimp catch increased to 295,000 pounds. Morro Bay landings were 199,000; Bodega Bay, 51,000; and Crescent City, 45,000 pounds. Many of the fishing and processing problems had been solved, and the central and northern areas whose potentials are by far the greatest were showing signs of extensive production possibilities.

The 1954 season opening on May 1st saw fishing activity on the beds off Morro Bay, Bodega Bay, and Crescent City. The total catch of shrimp to June 30, 1954, was 106,000 pounds, with shrimp production abnormally low at Morro Bay, good at Bodega Bay, and the majority of the State's 1954 production landed at Crescent City.

## THE SALTON SEA

The Salton Sea, California's largest inland body of water, long has been considered a potential fisherman's paradise, but sporadic fish plantings beginning in 1929

never have been really successful, and until recently no coordinated program of study to determine the potential has been made.

However, in 1953 the Wildlife Conservation Board authorized $86,000 for a three-year study, known as the Salton Sea Project. The study was placed under a service agreement with the University of California at Los Angeles in February, 1954. Active work began at Fish Springs late in March after necessary personnel was hired and basic equipment obtained. To date research people feel that the sea must be considered only a temporary habitat for fishes, but believe it will be productive for at least 30 years.

Situated in the Imperial Valley in Imperial and Riverside Counties, the sea is 235 feet below mean sea level with a surface area of some 280 square miles. Its average depth is 10 feet with some spots more than 50 feet. Its salinity, which varies according to depth, currently is somewhat below that of normal sea water. Surface temperature varies from around 50 degrees in the winter to about 100 degrees in the summer.

### Sporadic Plantings

First fish plantings (striped bass, silver salmon and mudsuckers) were made by the Division of Fish and Game between October 20, 1929, and late in 1934. Mudsuckers which now abound in the marginal areas of the sea are presumed to have resulted from a November, 1930, planting of 500 individuals. Nothing has ever been seen or heard of the striped bass and silver salmon. Not until 1948 was fish introduction again attempted and not until 1950 were these efforts anything but sporadic. Between 1950 and 1953 one kind of squid, four kinds of clams, three of mussels, two of oysters, one of shrimp, and one of crab were introduced from California, Japan, and Mexico in attempts to increase the food available to fish life. Of these forms two of the four species of clams, both species of oysters and the crab have survived from one to several years.

Mangrove seeds brought from Magdalena Bay, Baja California, in an attempt to modify the ecology of Salton Sea did not survive.

Of numerous fish species introduced during this period two from the Gulf of California (a croaker and a corvina) are known to have survived and spawned, and the resultant offspring to have survived and spawned.

## SURF FISHING INVESTIGATIONS

Continued investigation of the surf fishing off Southern California, to determine information needed for proper management of the major species, was carried out as Dingell-Johnson Project F-5-R. Work consists of studies on age and rate of growth, maturity and fecundity, and food analysis. Some tagging has been done and more is planned to determine movements and migrations. Recently underwater observation has contributed substantially to a better understanding of the ecology and habits of the species, and of the design and operation of beach seines.

Investigations are concerned with four species, all of which have been designated by law for sport fishing. In order of importance by numbers caught, they are the barred perch, spotfin croaker, California corbina, and yellowfin croaker. (North of Point Arguello the barred perch may be taken commercially.)

Statistics based on information supplied by surf fishermen in the form of daily catch records show that the barred perch makes up 78.5 percent of the catch. The other three are taken in the following percentages: spotfin croaker, 9.5; corbina 9.0; and yellowfin croaker 3.0 percent. Other species of surf fish taken in order of their importance are white croaker, opaleye, pile perch, and black perch. Several kinds of shark also are taken incidentally.

### Some Tagging Done

Biological material for the studies is supplied by beach seining monthly throughout the year at six stations from the Santa Barbara area to San Diego. Some tagging has also been done and more is planned for the future in order that movements and migrations can be learned. Returns to date indicate that two of the croakers, the spotfin and yellowfin, move as much as 45 miles in three months. The other two species, corbina and barred perch, have shown only minor movements no greater than two miles, recoveries being usually at the point of tagging.

Data taken routinely by beach seining have been supplemented at several perch derbies held by sportsmen during the last two years.

Maturity and fecundity studies of the egg-bearing croakers must be done by microscopic egg measurement and by egg counts. Information about food habits is being learned from microscopic examination of stomach contents. Age work is progressing on three of the four species. The barred perch, because of its importance, is taking priority.

### Yellowtail Investigations

More than 3,000 yellowtail were tagged during the past two years to make a good start toward obtaining the life history knowledge necessary for sound management of the fishery. A boat catch analysis of the commercial yellowtail fishery has been difficult because of the economic uncertainty of the fishery. Boats landing these fish usually are after the more valued species and take yellowtail only when the others cannot be readily found.

Data for life history studies have been obtained from cannery sampling whenever possible. Among the questions which need to be answered are whether the fish-

*Typical gear used for sablefish by commercial fishermen off the north coast. Fisherman is baiting a long-line set. The department conducted tagging operations from this and similar boats.*

ery is dependent on resident fish or whether they move from areas of abundance to the heavily fished California grounds, where spawning and nursery grounds are located, and relationship of oceanic conditions to abundance.

Current yellowtail investigations have been designated as Dingell-Johnson Project F-1-R, one of the few D-J projects in the Nation devoted to the betterment of an ocean fishery and certainly one of the most extensive. The yellowtail, as well as being a commercial fish, is one of the most prized ocean sport fish and sportsmen travel hundreds of miles in its pursuit. Once plentiful along the entire Southern California coast, it now is seldom taken except in the San Diego area.

Other phases of the program include development of marking devices, study of movements and measurements for descriptive purposes, as well as population studies.

### Sablefish

Sablefish form the basis of a minor but steady fishery along the Pacific Coast, primarily because of the popularity of the product in a smoked form. Since 1946 the average annual Pacific Coast landings have been 10,000,000 pounds, with California accounting for about 2,000,000 pounds annually. The fishery is exploited by both longline and otter trawl fishermen.

An investigation of the sablefish resources along the Pacific Coast was started during the previous biennium, upon recommendation of the Pacific Marine Fisheries Commission. Joint studies have been conducted along the coast by trained biologists in California, Oregon, Washington, Canada (British Columbia) and Alaska. Most phases of this investigation were completed during this biennium and the results are to be included in Bulletin No. 3 of the Pacific Marine Fisheries Commission.

Some of the results of this investigation in which California participated are as follows:

Results of fish tag recoveries are in agreement with the results of the racial study based on meristic counts —namely, that the greatest proportion of tag returns were from fish that were taken in the same general localities where they had been released.

Studies of the abundance of this species, by analysis of fishing returns, indicate that the catch-per-trip appears to have remained constant since 1941 in California. Furthermore, the fluctuations in seasonal catches are quite closely correlated with economic factors. Inasmuch as the greatest portion of the catch along the Pacific Coast is placed in cold storage for future smoking, abnormally large cold storage holdings at the start of a year are associated with relatively low catches in the ensuing year, and vice versa.

In addition, considerable life history information was obtained during the course of this investigation, such as spawning season and size at maturity, growth rates, length-weight relationships, and relationship between size of fish and depth of water.

To discourage the landing of small, immature fish, a minimum size of 25 inches total length or three pounds dressed, head off, was recommended as a regulation for the Pacific Coast, north of Pt. Arena, California.

## RESEARCH VESSELS

*N. B. Scofield:* Cruising Pacific waters from off Guayaquil, Ecuador, at three degrees south latitude, to Neah Bay, Washington, at 46 degrees N., the department's research vessel *N. B. Scofield* covered distances of 2,200 miles south of its home port, 700 miles north, and about the same distance west in a varied and versatile two-year program. No more graphic illustration can be presented of the far flung nature of marine fish populations. and the vast biological research necessary to administer these fisheries.

During the biennium the *Scofield* and her crew spent 389 days at sea, with tuna research of various types receiving the most attention.

Varied work done by this vessel is equally indicative of how versatile marine research vessels and marine biologists must be. In southern and off-shore waters the *Scofield* operated longline gear to search deeper water layers for populations of yellowfin tuna, bigeye tuna and albacore. This experimental fishing made contributions toward delimiting the distribution of these species and aided fishermen in assessing use of longline gear in the eastern Pacific. Physical and chemical oceanographic data were also collected. On other cruises in Mexican and California waters albacore, yellowfin tuna and skipjack were tagged.

### Yellowtail Tagging

One trip was made to the Southern California Channel Islands where kelp bass, caught at San Clemente Island, were tagged and released off Santa Catalina Island, a part of the ocean sport fishery studies. The yellowtail program was aided by two trips along the coast of Baja California where yellowtail were caught,

tagged and released. On one of these cruises mangrove seeds were brought back and planted in Salton Sea, one phase of the plan for developing a sport fishery in this inland body of salt water.

Two cruises in Central California waters resulted in the development of a mid-depth trawl that can be operated from a single vessel. Shrimp populations in the area were also assessed and this fishery given additional stimulus. One other trip made in connection with the trawl studies extended to the coastal waters of Washington and comprised assessments of bottom fish populations off Central and Northern California and Oregon and Washington.

*Yellowfin:* Although the work of the *Yellowfin* was not as varied as that of the *N. B. Scofield*, this vessel kept equally busy, spending 373 days at sea during the biennium. In the fall of 1952 she made four cruises along the coast of Baja California waters and three in the fall of 1953. On these trips, covering the area between Magdalena Bay, latitude 25 degrees N. and Pt. Reyes, latitude 38 degrees N., a census was taken of the abundance of sardines, Pacific and jack mackerel and anchovies, and of the relative numbers of the year class of sardines resulting from the previous spring spawning, when these fish were about six months old.

One of the outstanding accomplishments resulting from the work aboard the *Yellowfin* has been the development in the past year of a blanket net for the rapid and efficient collection of fish samples. This net and its successful operation resulted from the ingenuity and industry of the vessel crew and illustrates the importance of the contributions that every member of the staff makes to the department's marine research programs.

### Marine Research Cruises

In addition to the census of fish populations carried out by the *Yellowfin*, she made three oceanographic cruises in Southern and Baja California waters collecting plankton samples and physical and chemical oceanographic data, a part of the cooperative investigations being carried out under the direction of the Marine Research Committee. Five cruises were made in Southern and Baja California waters during the spring and early summer to study abundance of sardines, jack and Pacific mackerel and anchovies. Two trips were made around the Southern California Channel Islands to determine the condition of abalones in these waters.

*Nautilus:* Added to the department's research fleet during the biennium was the *Nautilus*, formerly the *Sportfisher II*, a standard northern drag boat, to serve as a mother ship for the abalone investigations. The new vessel, purchased in June, 1953, will serve as a base to dry and thaw out divers, for tagging and measuring abalones, and as a supply depot. It will be able to work in areas impossible for the 26-foot diving boat *Mollusk*, and will be available for many other investigations when not being used in abalone work.

Additional gear is being installed on the vessel to broaden its scope and usefulness. Among the installations are radar, enabling crews to take the boat close to shore in bad weather; a sonar "Sea Scanar" showing size and depth of underwater obstructions, and schools of fish within 1,600 feet; radio equipment; an anchor winch; and crew facilities. It already is equipped with Loran, a Bendix recording depth finder and two drag winches.

The *Nautilus* will be based at Redwood City, closest harbor to the Marine Fisheries Branch office at Stanford University. Storage located there consolidates equipment formerly kept at four scattered locations.

### FISH SCREENS AND LADDERS

A coordinated fish screen and ladder program, improved in some respects through reorganization and decentralization of the department, resulted in several far-reaching developments. These include new types of screens, devices to prevent trash accumulation, and improvement and remodeling of ladders. Added efficiency through decentralization of repair facilities was another major accomplishment. Assistance from the Dingell-Johnson Federal Aid Project F-4-D, on stream and lake improvement, came in the form of repair and remodeling of several existing fishways on coastal waters.

Under regional organization a new machine shop was established in Red Bluff. Besides servicing screens in Trinity County, the new shop maintained screens and ladders in the southern part of Region I, formerly handled by the Elk Grove shop. This eliminated much travel time for employees of the latter shop in servicing distant screens. The Yreka shop continued to handle screen and ladder construction and maintenance in the northern portion of the region.

Transferred to Region II from Marine Fisheries in 1953, the Elk Grove shop has been engaged in developing and testing new types of screens as well as in prefabricating conventional perforated plate models.

*Newly designed fish screen for diversions, showing automatic gate in open position. The gate prevents loss of head in canal when debris has accumulated on screen.*

A hydraulic drive mechanism for keeping screens free from trash, recently developed by department personnel, has been simplified and improved.

### Coordinates Program

To make most efficient use of shop facilities in Regions I and II a member of the headquarters staff coordinates the program and establishes state-wide priority for screen and ladder construction and installation. Screen activities have been confined mainly to the northern part of the State, where serious losses of young salmon and steelhead trout occur in irrigation diversion canals. Perforated plate type screens were installed in 23 water diversions in Siskiyou and Trinity Counties in addition to maintaining existing screens.

An outstanding innovation in fish screen design, an automatic safety gate, was developed by Ernest Murphey of the Yreka shop. This gate is opened automatically by a float arrangement when the water level on the downstream side of the screen drops appreciably, insuring a full flow in the diversion even in the event of mechanical failure in the cleaning mechanism. Several irrigation districts and other water users, formerly opposed to screen installation in their canals, were favorably impressed with the design, and approved installation of screens equipped with the new gate.

Among the projects of the Elk Grove shop was remodeling of ladders at Clough Dam, and the lower dam of the Los Molinos Mutual Water Company on Mill Creek in Tehama County. Two fish ladders on the Stanford-Vina Dam on Deer Creek in the same county also were renovated. Federal aid project crews repaired fish ladders on Sweasey Dam on Mad River in Humboldt County, and on Van Arsdale Dam on the Eel River in Mendocino County. Jumping pools were added to the San Geronimo Creek ladder in Marin County, and on the Old Creek ladder in San Luis Obispo County.

### Louver Type Screen

A louver type fish screen patterned after U. S. Fish and Wildlife Service experimental installations at Tracy, built at the Elk Grove shop, was tested at a water diversion on Deer Creek in Tehama County. This installation consisted of a series of vertical baffles placed diagonally across a channel with a bypass opening at the downstream end of the structure. Fish resist the change in water velocity through the openings between the baffles or louvers and are carried along the line of louvers into a bypass.

While young salmon and yearling steelhead trout were successfully deflected by this device, trash gradually accumulated on the vanes, causing considerable head loss in the canal. It is believed that the debris problem can be solved either by using wider spacing between the individual louvers to allow trash to drift through the screen or by developing a cleaning device for intermittent operation when the head loss at the screen reaches a predetermined point.

## SEISMIC EXPLORATIONS

Department of Fish and Game personnel continued to act as observers on all offshore seismic oil explorations conducted by use of explosives, and to report all observed damage of marine life. Each seismic exploration crew is accompanied at all times by an official representative of the department, whose principal duty is to observe the operation and take whatever steps are necessary to keep damage to marine life to an absolute minimum. Oil companies holding seismic permits from the Fish and Game Commission must defray costs of the department observers.

From July 1, 1952, until June 30, 1953, there was but a single oil survey crew working in California's coastal waters. During this period the crew detonated 1,414,790 pounds of black powder with an observed kill of 614 fish representing about a dozen species. During the second half of the biennium, July 1, 1953, to June 30, 1954, one seismic crew operated the entire time, a second operated from July 28 to May 31, a third from December 2 through May 31, and a fourth from January 6 through May 20. These four crews set off a total of 4,533,080 pounds of black powder with an observed kill of 2,057 fish. In addition a fifth crew, in the spring of 1954, carried out some experimental work under special permit from the Fish and Game Commission.

In addition to seismic permits which allow the use of black powder only, several permits were granted various construction companies for use of high explosives to remove pier structures, build sewer outfalls and control teredos. Few of these operations lasted more than two or three days but a department employee was on the spot to observe and oversee the operation and report all observed damage to marine life.

*Crab traps being set from a typical crab boat off central California.*

## PACIFIC MARINE FISHERIES COMMISSION

Continued strides in promoting better use of fisheries which are of mutual concern to California, Oregon, and Washington, and in development of a joint conservation program were made by the Pacific Marine Fisheries Commission during the past biennium. Formed in 1947 as a result of an interstate compact between the three states, the commission concentrates on coordinating the research activities of fisheries investigating agencies connected with the commission's staff.

All general and staff meetings are attended by research staff members from Canada, Alaska, and the U. S. Fish and Wildlife Service. Whenever possible these men have attempted to coordinate their own programs with those of the member states.

A research coordinator employed by the commission devotes much of his time to help research agencies avoid duplication, eliminate gaps in the work, and develop joint programs to find answers which can be applied along the entire Pacific Coast from California north.

### Cooperative Tagging

One such program was the troll salmon investigation, a cooperative tagging program involving thousands of ocean salmon entered by all three states, Canada, and Alaska. Later the three states marked millions of young king and silver salmon in the streams, and the ocean salmon catch was sampled from California to Alaska. Although the tagging program has been concluded there will be marked fish at sea until 1956.

Results so far obtained have conclusively shown that king and silver salmon move such distances at sea that a disaster in the salmon streams of one state can affect the ocean fishery far beyond its borders. For example, the mark returns have indicated that in some years there may be more Sacramento River salmon taken in Oregon and Washington combined than in the California ocean fishery.

Prior to 1952 the commission's investigations, meetings, discussions, and recommendations had resulted in troll salmon laws which were essentially the same in the three states. A further change in the silver salmon laws was then recommended and was passed by the California Legislature, to become effective as soon as Oregon and Washington make a similar change in their laws. A portion of the law recommended by the commission would delay opening of the silver salmon season in California from May 1st to July 1st.

The commission did not regard any size limit as necessary, but instead of eliminating the size limit entirely, the Legislature reduced it to 22 inches. Almost 100 percent of silver salmon taken are in their third year. In May most of that year's crop measures under 25 inches, but by July almost 90 percent are over that length. Thus the 22-inch limit serves to protect second-year fish which are actually much smaller than 22 inches.

*Catching yellowtail for tagging purposes off Guadalupe Island.*

A sablefish investigation started by the commission has included racial studies, tagging, and boat catch analysis. This work has demonstrated that sablefish wander relatively little and that California's stocks are in reasonably good condition.

The commission was instrumental in obtaining $10,000 for pollution studies by the U. S. Public Health Service. An additional $20,000 from the State of Washington went into this work which was conducted at Washington's Bowman's Bay Laboratory, and which has been aimed at finding the effect of paper mill waste on young salmon. One interesting discovery has been that many of the food organisms utilized by young salmon are killed at lower concentrations of sulfite waste than are the salmon themselves.

Research on albacore is being conducted by the three states and by some additional organizations on the Pacific Coast. In October, 1953, the Fourth Pacific Tuna Conference requested that the Pacific Marine Fisheries Commission assume coordination of this work and this responsibility was accepted at the December, 1953, meeting.

### STATISTICAL UNIT

Installations and procedures of the Marine Fisheries statistical unit were modified during the biennium to complete more efficiently the task of gathering, compilation and publication of California fishery statistics.

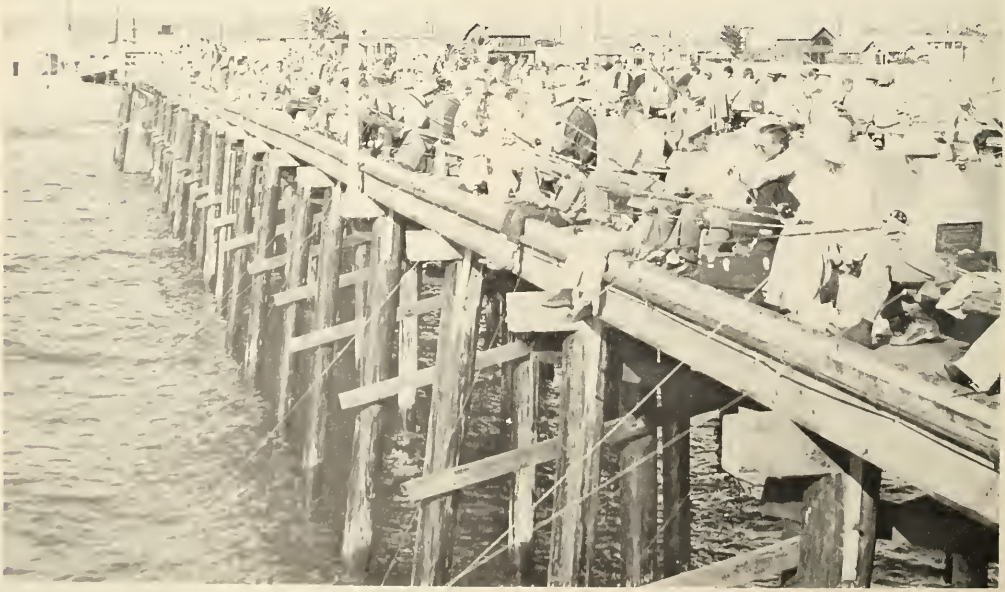
Among the modifications have been remodeling the building at Terminal Island, departmentalizing the organization, basic reports revised to increase their utility, license and application forms redesigned, trawl statistics for war years compiled and made available, marine sports catch records retabulated, and the striped bass catch logs have been tabulated.

The staff issued five publications during the biennium. Of these, two are statistical circulars and three are catch bulletins. Statistical Circulars Nos. 27 and 28 present the annual statistics of fresh and canned fishery products for the years 1952 and 1953 respectively. Circular 28 contains revised tables of sardine landings and production and a table showing the annual case pack of anchovy. These tables reflect the decline in importance of the sardine and the steadily increasing anchovy fishery which has risen from twenty-second position among the more important commercial species in 1945 to third position in 1953. Fish Bulletins Nos. 86, 89 and 95 present the complete commercial fish catch for the years 1950, 1951 and 1952 respectively. In addition, Bulletin No. 86 contains a historical record and a complete description of current methods used in collecting and compiling fisheries statistics.

### MARINE RESEARCH COMMITTEE

Investigative work of the Marine Research Committee continued throughout the biennium, although hampered by lack of funds as a result of failure of the sardine industry. The committee, consisting of nine members representing the fishing industry, Department of Fish and Game, and representative of the public, administers funds from a special tax on processed sardine, mackerel, anchovy, herring and squid. It coordinates the work of five agencies, including the California Academy of Sciences, California Department of Fish and Game, Scripps Institution of Oceanography, Hopkins Marine Station, and U. S. Fish and Wildlife Service.

*Need for access to ocean fishing along the shoreline is demonstrated by this crowded public pier in southern California. Public access for rock and surf fishing is one of the major points of the department's ten-year program.*



# APPENDICES

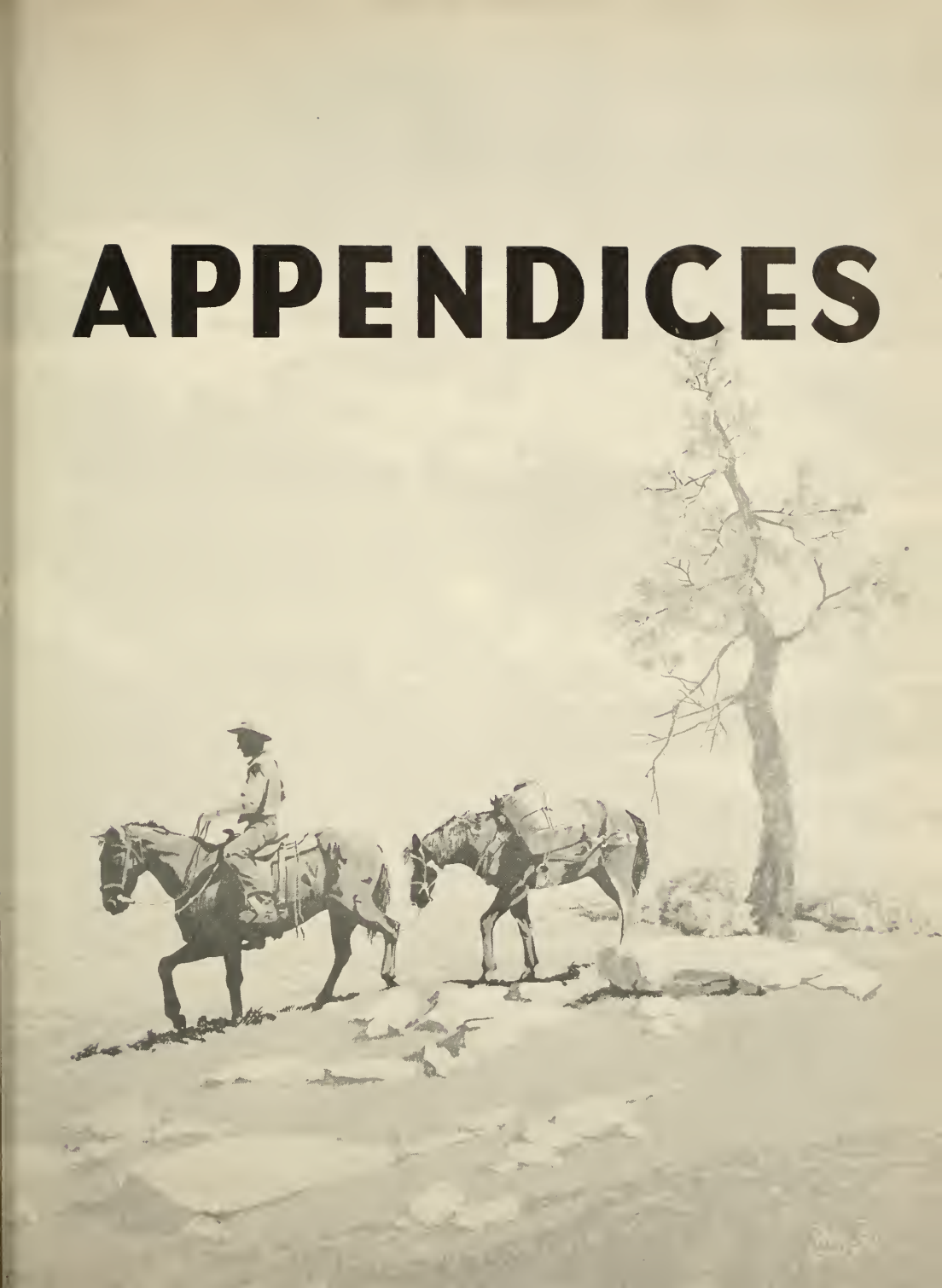


TABLE 1

## FISH AND GAME PRESERVATION FUND
## SUMMARY OF REVENUES, EXPENDITURES AND SURPLUS

| | 1952-53 Fiscal Year | 1953-54 Fiscal Year |
|---|---|---|
| Total state revenue—all sources | $6,282,445 | $6,775,886 |
| Total expenditures | 6,589,227 | 6,976,929 |
| Sub-division of expenditures: | | |
| Salaries and wages | 3,277,204 | 3,625,210 |
| Number of positions: | | |
| Support | | |
| Filled | (743.9) | (769.2) |
| Gross authorized | (829.7) | (829.2) |
| Federal aid | | |
| Filled | (97.0) | (112.0) |
| Gross authorized | (97.0) | (112.0) |
| Operating expense | 2,253,990 | 2,338,885 |
| Equipment | 372,520 | 262,843 |
| Less reimbursements | −122,143 | −193,141 |
| Sub-division of expenditures—Continued | | |
| State Employees' Retirement | $317,244 | $359,916 |
| Pittman-Robertson—(state funds) | 183,853 | 203,381 |
| Dingell-Johnson—(state funds) | 23,077 | 36,617 |
| Board of control claims | 7,758 | 106 |
| Capital outlay | 124,063 | 251,062 |
| Pacific Marine Fisheries Commission | 15,100 | 16,500 |
| Marine Research Committee | 136,561 | 75,550 |
| Prior year adjustments to surplus | +46,134 | +48,380 |
| Accumulated surplus—June 30 | 5,524,206 | 5,371,543 |
| Operating deficit (includes prior year adjustments) | 260,648 | 152,663 |

TABLE 2

## FISH AND GAME PRESERVATION FUND
## STATEMENT OF REVENUE

| | 1952-53 Fiscal Year | 1953-54 Fiscal Year |
|---|---|---|
| Department of Fish and Game, License Sales | | |
| Angling | $3,475,822 | $3,776,546 |
| Archery—deer tags | 2,595 | 3,316 |
| Commercial hunting club | 700 | 850 |
| Commercial hunting club operator | 250 | 310 |
| Deer tags | 374,419 | 375,407 |
| Fish breeder | 1,345 | 1,830 |
| Fish importer | 50 | 20 |
| Fish dealers and fish packers | 2,855 | 1,635 |
| Fish canners and processors | | |
| Fish tags | 10,818 | 11,943 |
| Fishing party boat permit | 955 | 2,342 |
| Boat registrations | | 33,120 |
| Salmon tags | 336 | 231 |
| Game breeders | 6,820 | 8,020 |
| Bird club license and tags | 3,911 | 4,369 |
| Game tags | 1,959 | 748 |
| Migratory game bird feeding | | 740 |
| Hunting | 1,701,849 | 1,765,121 |
| Kelp harvesters | 30 | 30 |
| Commercial fisherman | 115,870 | 121,622 |
| Trapping | 908 | 950 |
| Guide licenses | | 770 |
| Deer meat permits | 9,108 | 9,373 |
| Deer meat agents—wardens | 1,362 | 1,793 |
| Waterfowl shooting permits | 21,277 | 71,877 |
| Pheasant tags | 205,016 | 214,743 |
| Special big game hunts | 14,053 | 8,692 |
| Totals, license sales | $5,952,308 | $6,416,398 |
| Less: Commissions retained by agents selling licenses | —$288,269 | —$308,287 |
| Net revenue from license sales | $5,664,039 | $6,108,111 |
| Court fines | 146,650 | 141,909 |
| Taxes: | | |
| Fish packers and fish dealers tax | 176,889 | 209,875 |
| Salmon tax | 40,672 | 41,088 |
| Kelp harvester tax | 5,145 | 7,668 |
| Miscellaneous: | | |
| Lease of kelp beds | 4,297 | 4,384 |
| Confiscated fish | 7,196 | 12,935 |
| Oil royalties | 3,082 | 2,930 |
| Miscellaneous revenue | 29,106 | 37,631 |
| Total | $6,077,076 | $6,566,531 |
| Marine Research Committee, Taxes: | | |
| Sardine | 5,816 | 4,262 |
| Mackerel | 77,913 | 20,551 |
| Anchovie | 44,788 | 28,897 |
| Herring | 1,264 | 1,217 |
| Squid | 77 | 3,385 |
| Total, Marine Research Committee | $129,858 | $58,312 |
| Total, revenue excluding interest on investments | $6,206,934 | $6,624,843 |
| Interest on investments | 75,511 | 151,043 |
| Total revenue | $6,282,445 | $6,775,886 |

TABLE 3

## FISH AND GAME PRESERVATION FUND

### 1952-53 FISCAL YEAR EXPENDITURES

| | State | Federal aid | Total, state and federal |
|---|---|---|---|
| Wildlife Protection | $1,634,088 | | $1,634,088 |
| Inland Fisheries | 1,252,620 | | 1,252,620 |
| Game Management | 1,196,719 | | 1,196,719 |
| Federal aid: research and development | | | |
| Game | 183,853 | 551,558 | 735,411 |
| Inland Fisheries | 14,055 | 42,168 | 56,223 |
| Marine Fisheries | 9,022 | 27,065 | 36,087 |
| Total—federal aid | $206,930 | $620,791 | $827,721 |
| Marine Fisheries[1] | 870,685 | | 870,685 |
| Regional management | 334,737 | | 334,737 |
| Administrative services | 516,905 | | 516,905 |
| Staff management services | 271,681 | | 271,681 |
| Fixed charges: | | | |
| General administrative charges | 92,027 | | 92,027 |
| Accident and death claims | 28,617 | | 28,617 |
| Automobile insurance | 22,479 | | 22,479 |
| Attorney general services | 6,000 | | 6,000 |
| Total fixed charges | $149,123 | | $149,123 |
| Conservation Education | 128,661 | | 128,661 |
| Commission | 27,078 | | 27,078 |
| Totals | $6,589,227 | $620,791 | $7,210,018 |

[1]Includes Marine Research Committee Expenditures of $136,561 and Pacific Marine Fisheries Commission of $15,100.

### 1953-54 FISCAL YEAR EXPENDITURES

| | State | Federal aid | Total, state and federal |
|---|---|---|---|
| Wildlife Protection | $1,773,941 | | $1,773,941 |
| Inland Fisheries | 1,381,389 | | 1,381,389 |
| Game Management | 1,132,888 | | 1,132,888 |
| Federal aid—research and development: | | | |
| Game | 203,381 | $610,142 | 813,523 |
| Inland Fisheries | 26,403 | 79,208 | 105,611 |
| Marine Fisheries | 10,214 | 30,642 | 40,856 |
| Total—federal aid | $239,998 | $719,992 | $959,990 |
| Marine Fisheries[2] | 829,511 | | 829,511 |
| Regional management | 542,511 | | 542,511 |
| Administrative services | 417,805 | | 417,805 |
| Staff management services | 289,545 | | 289,545 |
| Fixed charges: | | | |
| General administrative charges | 87,160 | | 87,160 |
| Accident and death claims | 56,560 | | 56,560 |
| Automobile insurance | 24,438 | | 24,438 |
| Attorney general services | 19,799 | | 19,799 |
| Total fixed charges | $187,957 | | $187,957 |
| Conservation Education | 151,309 | | 151,309 |
| Commission | 30,075 | | 30,075 |
| Totals | $6,976,929 | $719,992 | $7,696,921 |

[2]Includes Marine Research Committee Expenditures of $75,500 and Pacific Marine Fisheries Commission of $16,500.

TABLE 4

## WILDLIFE CONSERVATION BOARD—WILDLIFE RESTORATION FUND
### 1952-53 FISCAL YEAR EXPENDITURES

| | | |
|---|---|---|
| Support | | |
| Salaries and wages | $20,250 | |
| Operating expenses | 14,539 | |
| Equipment | 293 | |
| | | $35,082 |
| Claim of Secretary, Board of Control | | 927 |
| Contribution to Retirement System | | 1,426 |
| Total | | $37,435 |
| Capital outlay projects | | |
| Fish hatchery and stocking projects | | 490,371 |
| Warm water and other fish projects | | 14,513 |
| Flow maintenance and stream improvement projects | | 30,369 |
| Fish screen and ladder projects | | 43,424 |
| Game farm projects | | |
| Upland game projects for quail habitat and pheasant development | | —492 |
| Waterfowl projects for acquisition and improvements of feeding and shooting grounds | | 530,063 |
| General projects of acquisition and construction | | 1,155 |
| Total | | $1,109,403 |
| Total expenditures | | $1,146,838 |

TABLE 5

## WILDLIFE CONSERVATION BOARD—WILDLIFE RESTORATION FUND
### 1953-54 FISCAL YEAR EXPENDITURES

| | | |
|---|---|---|
| Support | | |
| Salaries and wages | $23,571 | |
| Operating expenses | 11,940 | |
| Equipment | 1,216 | |
| | | $36,727 |
| Contribution to Retirement System | | 1,747 |
| Total | | $37,435 |
| Capital outlay projects | | |
| Fish hatchery and stocking projects | | 884,216 |
| Warm water and other fish projects | | 54,311 |
| Flow maintenance and stream improvement projects | | 98,645 |
| Fish screen and ladder projects | | —6,630 |
| Game farm projects | | |
| Upland game projects for quail habitat and pheasant development | | 24,220 |
| Waterfowl projects for acquisition and improvements of feeding and shooting grounds | | 713,935 |
| General projects of acquisition and construction | | 1,300 |
| Total | | $1,769,997 |
| Total expenditures | | $1,808,471 |

TABLE 6

## SUMMARY OF COSTS FOR 10-YEAR PROGRAM

| | Estimated cost of recommended project | Estimated annual operation and maintenance costs |
|---|---|---|
| Marine fisheries | $7,100,000 | $65,000 |
| Inland fisheries | 11,500,000 | 795,000 |
| Salmon and steelhead program | 3,950,000 | |
| Subtotal for fisheries improvement | $22,550,000 | |
| Hunting opportunities | 20,000,000 | 2,700,000 |
| Economic survey | 15,000 | |
| Totals | $42,565,000 | $3,560,000 |
| Average per year | $4,256,500 | *$3,560,000 |

*This represents estimated annual cost of operating fully developed program. During period of development, the operating costs will be approximately half of the ultimate cost of operation.

### INLAND FISHERIES

| | Estimated cost of recommended project | Estimated annual operation and maintenance costs |
|---|---|---|
| Warm water fishing | $5,000,000 | $350,000 |
| Public access | 2,000,000 | Negligible |
| Stream and lake improvement | 1,600,000 | 20,000 |
| Coastal lagoons | 500,000 | 25,000 |
| Chemical treatment | 500,000 | |
| Catchable trout | 1,900,000 | 400,000 |
| Totals | $11,500,000 | $795,000 |
| Average per year | $1,150,000 | *$795,000 |

*This represents estimated annual cost of operating fully developed program. During period of development, the operating costs will be approximately half of the ultimate cost of operation.

### HUNTING OPPORTUNITIES

| | Estimated cost of recommended project | Estimated annual operation and maintenance costs |
|---|---|---|
| Waterfowl management areas | $15,000,000 | $2,000,000 |
| Upland game habitat development | 2,000,000 | |
| Upland game cooperative hunting areas | | 500,000 |
| Big game winter lands | 1,000,000 | |
| Right-of-way acquisition | 2,000,000 | |
| Operation of big game lands | | 200,000 |
| Totals | $20,000,000 | $2,700,000 |
| Average per year | $2,000,000 | *$2,700,000 |

*This represents estimated annual cost of operating fully developed program. During period of development, the operating costs will be approximately half of the ultimate cost of operation.

### MARINE FISHERIES

| | Estimated cost of recommended project | Estimated annual operation and maintenance costs |
|---|---|---|
| Cost of Marine Fisheries Projects: | | |
| a. Public fishing opportunity | | |
| (1) Ocean coast | | |
| Acquisition and development | $4,000,000 | |
| Maintenance, $20,000 to $75,000 per year | | $50,000 |
| (2) Saltwater bays | | |
| Acquisition and development | 750,000 | |
| Maintenance, $5,000 to $20,000 per year, average | | 15,000 |
| b. Development of potential fisheries, annual cost $50,000 for five years | 250,000 | |
| c. Pollution studies and control | 550,000 | |
| d. Intensified surveys | 1,550,000 | |
| Total marine fisheries projects | $7,100,000 | *$65,000 |

*This represents estimated annual cost of operating fully developed program. During period of development, the operating costs will be approximately half of the ultimate cost of operation.

### SALMON AND STEELHEAD

| | |
|---|---|
| a. Water projects—$75,000 per year, 10 years | $750,000 |
| b. Screens and ladders—$80,000 per year, 10 years | 800,000 |
| c. Coastal stream clearance—$50,000 per year, 5 years; $30,000 per year, 5 years | 400,000 |
| d. Barrier removal—$10,000 per year, 5 years | 50,000 |
| e. River mouth improvement—$20,000 per year, 10 years | 200,000 |
| f. Coastal stream flow maintenance | 750,000 |
| g. Artificial propagation | 1,000,000 |
| Total salmon and steelhead projects for 10-year program | $3,950,000 |
| Average per year | $395,000 |

TABLE 7

## PERMANENT LAND RADIO STATIONS, WILDLIFE PROTECTION

Sacramento, Region II Office
Sacramento State Police Office
San Francisco Region III Office
Monterey Office
Los Angeles Region V Office
Terminal Island Office
San Diego Office
Bridgeport Sheriff's Office
Independence Sheriff's Office (2 Units)
Colusa County Sheriff's Office
Yuba City Sheriff's Office
Modesto Fire Department
Merced County Fire Station
Bakersfield
San Bernardino
Hot Creek Fish Hatchery
Alturas Sheriff's Office
Eureka Fish and Game Office
Fish & Game Hangar, Sacramento
Quincy Sheriff's Office
Brawley

The 11 Mobile Relay (Repeater) Stations are installed at the following locations:

Happy Camp, Modoc County
Black Mountain, Lassen County
Mt. Diablo, Contra Costa County
Shirley Peak, Kern County
Santa Ynez Peak, Santa Barbara County
Oat Mountain, Los Angeles County
Catalina Island, Los Angeles County
Stevenson Peak, San Diego County
Silver Can, Inyo County
Conway Summit, Mono County
Red Hill, Plumas County

TABLE B

| Type of violation | Number arrests 1952-53 | Number arrests 1953-54 |
|---|---|---|
| Deer | 760 | 685 |
| Waterfowl | 667 | 442 |
| Dove and pigeon | 157 | 109 |
| Upland bird | 384 | 405 |
| Inland fish | 1,573 | 1,176 |
| Clam-abalone-ocean | 607 | 508 |
| Commercial fish | 238 | 501 |
| Loaded gun in car | 1,661 | 1,209 |
| Co-op trespass | 296 | 272 |
| Angling, no license | 1,493 | 1,513 |
| Hunting, no license | 267 | 165 |
| Miscellaneous | 617 | 566 |
| Totals | 8,720 | 7,551 |

TABLE 9

## TOTAL ARRESTS FOR PERIOD OF 52 YEARS

| | | | |
|---|---|---|---|
| 1902-1904 | 550 | 1928-1930 | 5,388 |
| 1904-1906 | 774 | 1930-1932 | 5,237 |
| 1906-1908 | 1,192 | 1932-1934 | 3,795 |
| 1908-1910 | 1,771 | 1934-1936 | 4,535 |
| 1910-1912 | 2,063 | 1936-1938 | 6,382 |
| 1912-1914 | 1,993 | 1938-1940 | 7,444 |
| 1914-1916 | 2,087 | 1940-1942 | 7,262 |
| 1916-1918 | 1,797 | 1942-1944 | 4,298 |
| 1918-1920 | 1,891 | 1944-1946 | 5,902 |
| 1920-1922 | 2,258 | 1946-1948 | 11,331 |
| 1922-1924 | 2,715 | 1948-1950 | 12,947 |
| 1924-1926 | 3,207 | 1950-1952 | 12,802 |
| 1926-1928 | 4,390 | 1952-1954 | 16,271 |

## ARRESTS AND CONVICTIONS—RECAPITULATION

| | 1952-1953 | 1953-1954 |
|---|---|---|
| Number of arrests | 8,720 | 7,551 |
| Fine | $306,108.50 | $292,479.64 |
| Jail sentences | 4,725 days | 8,111 days |

## TYPE OF CASE

| | 1952-53 | 1953-54 |
|---|---|---|
| Fish | 3,911 | 3,698 |
| Game | 4,192 | 3,287 |
| Miscellaneous | 617 | 556 |
| | 8,720 | 7,551 |

TABLE 10

## CREEL CENSUSES

**July 1, 1952, to June 30, 1954 (Inclusive)**

| *Name of water* | *County* |
|---|---|
| REGION I | |
| Big Lagoon | Humboldt |
| Clam Beach Lagoon | Humboldt |
| Eel River | Humboldt |
| Freshwater Lagoon | Humboldt |
| Klamath River | Humboldt and Siskiyou |
| Mad River | Humboldt |
| Stone Lagoon | Humboldt |
| Sacramento River (Keswick to Colusa) | Shasta, Tehama, Glenn, Colusa |
| Pit River | Shasta |
| Shasta Lake | Shasta |
| Castle Lake | Siskiyou |
| Copco Lake | Siskiyou |
| Sacramento River, South and Middle Forks | Siskiyou |
| Shasta River | Siskiyou |
| REGION II | |
| Trout Creek | El Dorado |
| Upper Truckee River | El Dorado |
| Boca Reservoir | Nevada |
| Truckee River | Nevada, Placer, and Sierra |
| Lake Tahoe | Placer and El Dorado |
| Donner Lake | Placer and Nevada |
| Feather River, North Fork | Plumas |
| Lakes Basin Recreation Area (18 lakes) | Plumas and Sierra |
| REGION III | |
| Clear Lake | Lake |
| San Lorenzo River | Santa Cruz |
| Gualala River | Sonoma |
| REGION IV | |
| Mendota Pool | Fresno |
| Sequoia Lake | Fresno |
| Shaver Lake | Fresno |
| Dam No. 7 Reservoir | Fresno and Madera |
| Millerton Lake | Fresno and Madera |
| San Joaquin River at Friant | Fresno and Madera |
| Kern River | Kern and Tulare |
| Rock Creek | Madera |
| Merced River | Merced |
| Brush Creek | Tulare |
| REGION V | |
| Imperial Reservoir | Imperial |
| Big Pine Creek | Inyo |
| Bishop Creek | Inyo |
| Independence Creek | Inyo |
| Lone Pine Creek | Inyo |
| Rock Creek Lake | Inyo |
| Sabrina Lake | Inyo |
| South Lake | Inyo |
| Crystal Lake | Los Angeles |
| Little Rock Reservoir | Los Angeles |
| Puddingstone Reservoir | Los Angeles |
| Bridgeport Reservoir | Mono |
| Convict Creek | Mono |
| Convict Lake | Mono |
| Crowley Lake | Mono |
| Grant Lake | Mono |
| June Lake | Mono |
| Lee Vining Creek | Mono |
| Mammoth Creek | Mono |
| Mary Lake | Mono |
| Rock Creek | Mono |
| Rush Creek | Mono |
| Silver Lake | Mono |
| Topaz Lake | Mono |
| Twin Lake (trib. Mammoth Creek) | Mono |

TABLE 11

## FISH DISTRIBUTION AND RESCUE

Fish Planted—July 1, 1952, to June 30, 1953 (Inclusive)—Hatchery Reared Fish Planted in Each County

| County | TROUT | | | | | SALMON | | | Total number of fish |
|---|---|---|---|---|---|---|---|---|---|
| | Rainbow | Steelhead | Eastern brook | Brown | Cutthroat | King | Kokanee | Silver | |
| Alpine | 484,783 | | 96,310 | | | | | | 581,093 |
| Amador | 190,103 | | 10,080 | | | | | | 200,183 |
| Butte | 19,276 | | | | | | | | 19,276 |
| Calaveras | 249,656 | | 1,000 | | | | | | 250,656 |
| Colusa | 5,420 | | | | | | | | 5,420 |
| Del Norte | | 378,100 | | | | | | | 378,100 |
| El Dorado | 848,335 | | 368,480 | | | | 283,530 | | 1,500,345 |
| Fresno | 869,903 | | 58,812 | | | | | | 928,715 |
| Glenn | 2,130 | | | | | | | | 2,130 |
| Humboldt | 143,357 | 311,912 | | | | 493,012 | | 12,391 | 960,672 |
| Inyo | 718,873 | | 24,689 | 357,052 | | | | | 1,100,614 |
| Kern | 196,694 | | | | | | | | 196,694 |
| Lake | 43,010 | | | | | | | | 43,010 |
| Lassen | 238,082 | | 28,800 | | | | 67,500 | | 334,382 |
| Los Angeles | 224,050 | | | | | | | | 224,050 |
| Madera | 345,541 | | 159,072 | | | | | | 504,613 |
| Marin | 58,058 | 7,845 | | | | | | | 65,903 |
| Mariposa | 594,097 | | 15,912 | | | | | | 610,009 |
| Mendocino | 8,020 | | | | | | | | 8,020 |
| Modoc | 48,172 | | | | | | | | 48,172 |
| Mono | 1,234,506 | | 42,879 | 285,250 | 125,000 | | | | 1,687,635 |
| Monterey | 19,585 | 10,000 | | | | | | | 29,585 |
| Napa | 95,888 | | | | | | | | 95,888 |
| Nevada | 455,586 | | 186,082 | | | | 94,900 | | 736,568 |
| Orange | 5,500 | | | | | | | | 5,500 |
| Placer | 489,400 | | 94,284 | | | | 120,016 | | 703,700 |
| Plumas | 305,715 | | 128,280 | | | | 180,000 | | 613,995 |
| Riverside | 96,700 | | | | | | | | 96,700 |
| Sacramento | 390 | | | | | | | | 390 |
| San Bernardino | 447,545 | | | | | | | | 447,545 |
| San Diego | 50,425 | | | | | | | | 50,425 |
| San Francisco | 116,742 | | | | | | | | 116,742 |
| San Luis Obispo | 47,324 | | | | | | | | 47,324 |
| San Mateo | 10,271 | 47,033 | | | | | | | 57,304 |
| Santa Barbara | 105,830 | | | | | | | | 105,830 |
| Santa Clara | 22,016 | | | | | | | | 22,016 |
| Santa Cruz | 57,614 | 213,974 | | | | | | | 271,588 |
| Shasta | 342,870 | | 36,662 | 79,000 | | | | | 458,532 |
| Sierra | 689,257 | | 125,937 | | | | | | 815,194 |
| Siskiyou | 377,584 | | 85,034 | | | 947,296 | 10,200 | | 1,420,114 |
| Solano | 15,032 | | | | | | | | 15,032 |
| Tehama | 81,307 | | 4,000 | | | | | | 85,307 |
| Trinity | 254,685 | | 46,696 | | | | | | 301,381 |
| Tulare | 728,125 | | | | | | | | 728,125 |
| Tuolumne | 993,359 | | 45,530 | | | | 10,440 | | 1,049,329 |
| Ventura | 109,452 | | | | | | | | 109,452 |
| Grand totals | 12,440,268 | 968,864 | 1,558,539 | 721,302 | 125,000 | 1,440,308 | 766,586 | 12,391 | 18,033,258 |

TABLE 10—Continued

| | |
|---|---|
| Twin Lake (trib. Robinson Creek) | Mono |
| Lower Virginia Lake | Mono |
| Upper Virginia Lake | Mono |
| East Walker River | Mono |
| West Walker River | Mono |
| Big Bear Lake | San Bernardino |
| Lake Havasu | San Bernardino |
| Colorado River | San Bernardino |
| Deep Creek | San Bernardino |
| Santa Ana River | San Bernardino |
| San Vincente Reservoir | San Diego |
| Cachuma Reservoir | Santa Barbara |

TABLE 12

## HATCHERY REARED WARMWATER FISHES

July 1, 1952, to June 30, 1953 (Inclusive)

| | Number of fish |
|---|---|
| Largemouth black bass | 71,773 |
| Smallmouth black bass | 18,285 |
| Fathead minnow | 2,000 |
| Golden shiners | 176,437 |
| Total | 268,495 |

TABLE 13

## FISH DISTRIBUTION AND RESCUE

Fish Planted—July 1, 1953, to June 30, 1954 (Inclusive)—Hatchery Reared Fish Planted in Each County

| County | TROUT | | | | | | SALMON | | Total number of fish |
|---|---|---|---|---|---|---|---|---|---|
| | Rainbow | Steelhead | Eastern brook | Brown | Cutthroat | Golden | King | Kokanee | |
| Alameda | 12,174 | | | | | | | | 12,174 |
| Alpine | 188,254 | | 133,743 | | 134,696 | | | | 456,693 |
| Amador | 44,502 | | 9,909 | | | | | | 54,411 |
| Butte | 27,007 | | | | | | | | 27,007 |
| Calaveras | 50,415 | | 5,020 | | | | | | 55,435 |
| Colusa | 8,645 | | | | | | | | 8,645 |
| Del Norte | | 187,500 | | 3,008 | | | 309,750 | | 500,258 |
| El Dorado | 926,788 | 4,600 | 347,827 | | 34,560 | | | 232,420 | 1,546,195 |
| Fresno | 807,720 | | 155,613 | | | 134,760 | | | 1,098,093 |
| Glenn | 4,980 | | | | | | | | 4,980 |
| Humboldt | 13,005 | 302,880 | 5,024 | | 99,009 | | 173,453 | | 593,371 |
| Inyo | 675,807 | | 19,542 | 341,556 | | 35,880 | | | 1,072,785 |
| Kern | 238,472 | | | | | | | | 238,472 |
| Lake | 56,702 | | 24,122 | | | | | | 80,824 |
| Lassen | 212,702 | | 69,375 | | | | | | 282,077 |
| Los Angeles | 187,825 | | | | | | | | 187,825 |
| Madera | 268,122 | | 63,916 | 6,360 | | 2,520 | | | 340,918 |
| Marin | 123,752 | | | | | | | | 123,752 |
| Mariposa | 607,625 | | 29,964 | | | | | | 637,589 |
| Mendocino | 8,940 | | | | | | | | 8,940 |
| Modoc | 350,473 | | | | | | | | 350,473 |
| Mono | 1,409,613 | | 211,670 | 490,869 | 171,476 | 21,895 | | | 2,305,523 |
| Monterey | 50,426 | | | | | | | | 50,426 |
| Napa | 77,101 | 200 | | | | | | | 77,301 |
| Nevada | 445,165 | | 241,003 | | | | | 60,480 | 746,648 |
| Orange | 14,650 | | | | | | | | 14,650 |
| Placer | 358,111 | | 96,082 | | | | | 337,765 | 791,958 |
| Plumas | 548,371 | | 102,490 | | | | | 150,150 | 801,011 |
| Riverside | 88,130 | | | | | | | | 88,130 |
| Sacramento | 200 | | | | | | | | 200 |
| San Bernardino | 488,390 | | | | | | | | 488,390 |
| San Diego | 49,580 | | | | | | | | 49,580 |
| San Francisco | 459,657 | | 90,000 | | | | | | 549,657 |
| San Luis Obispo | 62,985 | | | | | | | | 62,985 |
| San Mateo | 24,102 | | | | | | | | 24,102 |
| Santa Barbara | 178,699 | 16,502 | | | | | | | 195,201 |
| Santa Clara | 51,302 | | | | | | | | 51,302 |
| Santa Cruz | 61,734 | 5,635 | | | | | | | 67,369 |
| Shasta | 428,329 | | 43,500 | | | | | | 471,829 |
| Sierra | 442,532 | | 122,924 | | | | | | 565,456 |
| Siskiyou | 538,572 | | 109,572 | | | | 803,155 | 186,330 | 1,637,629 |
| Solano | 42,656 | | | | | | | | 42,656 |
| Tehama | 112,874 | | 18,502 | | | | | | 131,376 |
| Trinity | 289,078 | | 63,752 | | | | | | 352,830 |
| Tulare | 673,408 | | 42,665 | | | 6,240 | | | 722,313 |
| Tuolumne | 501,632 | | 136,942 | | | | | 48,825 | 687,399 |
| Ventura | 99,274 | 3,900 | | | | | | | 103,174 |
| Yuba | 14,010 | | | | | | | | 14,010 |
| Grand totals | 12,324,606 | 521,217 | 2,143,157 | 841,793 | 439,741 | 201,295 | 1,286,358 | 1,015,970 | 18,774,022 |

TABLE 14

## HATCHERY REARED SALMON AND TROUT PLANTED

July 1, 1953, to June 30, 1954 (Inclusive)

| Species | Number of fish |
|---|---|
| Rainbow Trout | 12,324,606 |
| Steelhead Trout | 521,217 |
| Eastern Brook Trout | 2,143,157 |
| Brown Trout | 841,793 |
| Cutthroat Trout | 439,741 |
| Golden Trout | 201,295 |
| King Salmon | 1,286,358 |
| Kokanee Salmon | 1,015,970 |
| Total | 18,774,022 |

TABLE 15

## HATCHERY REARED SALMON AND TROUT PLANTED

July 1, 1952, to June 30, 1953 (Inclusive)

| Species | Number of fish |
|---|---|
| Rainbow trout | 12,660,954 |
| Brown trout | 724,306 |
| Eastern brook trout | 1,557,535 |
| Steelhead trout | 968,864 |
| Cutthroat trout | 258,003 |
| Kokanee salmon | 507,303 |
| King salmon | 1,343,901 |
| Silver salmon | 12,392 |
| Total | 18,033,258 |

TABLE 16

## FISH RESCUED AND TRANSPLANTED

July 1, 1952, to June 30, 1953 (Inclusive)

| | |
|---|---|
| Trout | |
| Rainbow | 112 |
| Brown | 89 |
| Steelhead | 650,312 |
| Total | 650,513 |
| Salmon | |
| King | 16 |
| Silver | 47,586 |
| Total | 47,602 |
| Warmwater fishes | |
| Largemouth Black Bass | 52,990 |
| Smallmouth Black Bass | 20,340 |
| Warmouth Bass | 498 |
| Striped Bass | 351 |
| Bluegill Sunfish | 97,395 |
| Green Sunfish | 39,589 |
| Black Crappie | 44,342 |
| Brown Bullhead | 431,123 |
| White Catfish | 76,284 |
| Golden Shiner | 157,498 |
| Northern Anchovy | 6,000 |
| Short-fin Seabass | 94 |
| White Croaker | 35 |
| California Corbina | 8 |
| Thread Herring | 26 |
| California Pompano | 1 |
| Orange Mouth Seabass | 38 |
| Total | 926,612 |

TABLE 17

## FISH RESCUED AND TRANSPLANTED

July 1, 1953, to June 30, 1954 (Inclusive)

| | |
|---|---|
| Trout | |
| Rainbow | 1,095 |
| Steelhead | 947,990 |
| Brown | 602 |
| Cutthroat | 3 |
| Total | 949,690 |
| Salmon | |
| King Salmon | 13,409 |
| Silver Salmon | 26,400 |
| Total | 39,809 |
| Trout total | 949,690 |
| Salmon total | 39,809 |
| Warmwater total | 683,211 |
| Totals | 1,672,710 |
| Warm Water Fishes | |
| Largemouth Bass | 114,382 |
| Smallmouth Bass | 21,761 |
| Warmouth Bass | 240 |
| Striped Bass | 197 |
| Bluegill Sunfish | 240,800 |
| Green Sunfish | 17,711 |
| Black Crappie | 119,290 |
| Brown Bullhead | 81,466 |
| White Catfish | 29,862 |
| Channel Catfish | 5,423 |
| Golden Shiner | 51,025 |
| Shad | 27 |
| California Kilifish | 150 |
| Threadfin Shad | 877 |
| Total | 683,211 |

TABLE 18

## HATCHERY REARED WARMWATER FISHES

July 1, 1953, to June 30, 1954 (Inclusive)

| Species | Number of fish |
|---|---|
| Smallmouth Bass | 55,591 |
| Largemouth Bass | 78,849 |
| Golden Shiners | 76,551 |
| Fathead Minnows | 318,783 |
| Total | 529,774 |

TABLE 19

## INCREASED TRENDS IN TROUT PRODUCTION SINCE 1949

| | CATCHABLES | | FINGERLINGS | |
|---|---|---|---|---|
| | Number | Pounds | Number | Pounds |
| 1949-1950 | 2,501,182 | 417,855 | 16,290,943 | 70,542 |
| 1950-1951 | 2,833,599 | 468,339 | 14,918,164 | 61,901 |
| 1951-1952 | 3,675,305 | 539,554 | 11,815,287 | 40,182 |
| 1952-1953 | 4,580,840 | 747,721 | 13,452,418 | 40,826 |
| 1953-1954 | 5,261,740 | 796,384 | 13,512,282 | 46,747 |

TABLE 20

## CHEMICAL CONTROL OF UNDESIRABLE FISH POPULATIONS

July 1, 1952, to June 30, 1954 (Inclusive)

| Name of water | County | Surface area in acres | Date |
|---|---|---|---|
| REGION I | | | |
| None noted | | | |
| REGION II | | | |
| Summit Lake | Nevada | 8.4 | Aug. 1952 |
| Catfish Lake | Nevada | 9.3 | Aug. 1952 |
| McMurray Lake | Nevada | 14.0 | Aug. 1952 |
| Taylor Lake | Plumas | 33.0 | Nov. 1952 |
| Beacon Road Gravel Pits (3) | Glenn | 6.0 | July 1953 |
| Round Lake | El Dorado | 40.0 | Aug. 1953 |
| REGION III | | | |
| Merced Lake | San Francisco | 375.0 | Nov. 1952 |
| Dow Pond | Contra Costa | 15.0 | June 1953 |
| Dry and Maacama Creeks | Sonoma | 87 miles | Sept. 1953 |
| Pine Lake | San Francisco | 1.0 | May 1954 |
| REGION IV | | | |
| Snelling Dredger Pond | Merced | 5.0 | Sept. 1953 |
| Buttonwillow Lakes (2) | Merced | 140.0 | Oct. 1953 |
| Olsen Pond | Merced | 10.0 | Oct. 1953 |
| Bass Lake | Madera | 1,165.0 | Nov. 1953 |
| Bass Lake tributaries | Madera | 10 miles | Nov. 1953 |
| Ruth Lakes (3) | Merced | 70.0 | Apr. 1954 |
| REGION V | | | |
| Tamarack Lake | Mono | 6.0 | Sept. 1952 |
| Tamarack Lake | Inyo | 5.0 | Sept. 1952 |
| Eleanore Lake | Ventura | 3.0 | Oct. 1953 |
| Crystal Lake* | Los Angeles | 5.0 | Nov. 1953 |
| Santa Ysabel Creek | San Diego | 4 miles | Nov. 1953 |
| Sutherland Reservoir | San Diego | 20.0 | Nov. 1953 |
| O'Neil Lake | San Diego | 400.0 | Dec. 1953 |
| Hansen Reservoir | Los Angeles | 130.0 | Mar. 1954 |

*Also treated to eradicate aquatic weeds.

TABLE 21

## FARM PONDS

July 1, 1952, to June 30, 1953 (Inclusive)

| Region | Number of applications | Number of ponds visited | Number of ponds stocked |
|---|---|---|---|
| I | 45 | 45 | 24 |
| II | ?* | — | 44 |
| III | 115† | 40 | 60† |
| IV | 37 | 20 | 45 |
| V | 111 | 25 | 90 |
| Totals | 308 | 130 | 263 |

*Unknown.
†Estimated.

July 1, 1953, to June 30, 1954 (Inclusive)

| Region | Number of applications | Number of ponds visited | Number of ponds stocked |
|---|---|---|---|
| I | 18 | 29 | 19 |
| II | 54 | — | 41 |
| III | 125 | 60 | 60† |
| IV | 61 | 40 | 49 |
| V | 85 | 23 | 73 |
| Totals | 343 | 152 | 242 |

†Estimated.

TABLE 22

## CATCHES OF LEADING INLAND SPORT FISHES IN 1953 AND 1951

| | 1953 | | 1951 | |
|---|---|---|---|---|
| | Total | Mean catch per angler | Total | Mean catch per angler |
| Trout | 22,300,000 | 41.9 | 18,600,000 | 43.3 |
| Striped bass | 1,590,000 | 9.5 | 1,490,000 | 10.4 |
| Black bass | 2,300,000 | 14.3 | 1,280,000 | 11.9 |
| Crappie | 3,570,000 | 26.6 | 2,380,000 | 31.3 |
| Sunfish | 6,200,000 | 46.3 | 4,800,000 | 47.1 |
| Catfish | 7,500,000 | 33.2 | 4,710,000 | 27.5 |
| Salmon | 640,000 | 5.8 | 564,000 | 7.2 |

TABLE 23

## INITIAL STREAM AND LAKE SURVEYS

July 1, 1952, to June 30, 1954 (Inclusive)

1952-53

| Region | Streams | Lakes |
|---|---|---|
| I | 9 | 33 |
| II | 9 | 61 |
| III | 20 | 15 |
| IV | 12 | 31 |
| V | 20 | 32 |
| Totals | 70 | 112 |

1953-54

| Region | Streams | Lakes |
|---|---|---|
| I | 14 | 23 |
| II | 0 | 46 |
| III | 25 | 19 |
| IV | 5 | 11 |
| V | 28 | 50 |
| Totals | 72 | 149 |

TABLE 24

## CALIFORNIA ANNUAL DEER KILL (REGULAR SEASON DEER TAG RETURNS)

| County of kill | Yearly average 1927-1949 | 1950 | 1951 | 1952 | 1953 |
|---|---|---|---|---|---|
| 1 Alameda | 336 | 386 | 580 | 627 | 763 |
| 2 Alpine | 435 | 1,306 | 1,755 | 1,277 | 1,638 |
| 3 Amador | 191 | 242 | 316 | 322 | 485 |
| 4 Butte | 418 | 794 | 785 | 849 | 1,040 |
| 5 Calaveras | 277 | 421 | 417 | 413 | 497 |
| 6 Colusa | 336 | 442 | 574 | 541 | 356 |
| 7 Contra Costa | 51 | 130 | 178 | 200 | 232 |
| 8 Del Norte | 29 | 53 | 41 | 28 | 33 |
| 9 El Dorado | 786 | 863 | 1,071 | 937 | 1,185 |
| 10 Fresno | 1,465 | 1,733 | 2,280 | 1,949 | 2,407 |
| 11 Glenn | 635 | 719 | 712 | 740 | 606 |
| 12 Humboldt | 1,163 | 1,770 | 2,313 | 1,792 | 2,323 |
| 13 Imperial | 4 | 10 | 8 | 16 | 23 |
| 14 Inyo | 417 | 303 | 718 | 308 | 593 |
| 15 Kern | 355 | 558 | 558 | 655 | 1,032 |
| 16 Kings | 11 | 31 | 38 | 29 | 30 |
| 17 Lake | 1,319 | 1,942 | 2,155 | 2,056 | 2,146 |
| 18 Lassen | 1,226 | 2,243 | 4,499 | 1,962 | 1,519 |
| 19 Los Angeles | 698 | 571 | 633 | 572 | 629 |
| 20 Madera | 487 | 508 | 623 | 665 | 745 |
| 21 Marin | 470 | 554 | 767 | 832 | 885 |
| 22 Mariposa | 221 | 202 | 240 | 232 | 248 |
| 23 Mendocino | 2,173 | 2,927 | 3,665 | 4,252 | 4,394 |
| 24 Merced | 90 | 199 | 252 | 388 | 388 |
| 25 Modoc | 1,728 | 2,230 | 6,077 | 1,794 | 1,076 |
| 26 Mono | 455 | 1,494 | 1,973 | 1,442 | 2,098 |
| 27 Monterey | 935 | 1,705 | 2,057 | 1,825 | 2,023 |
| 28 Napa | 659 | 952 | 983 | 1,220 | 1,161 |
| 29 Nevada | 555 | 939 | 1,327 | 972 | 1,277 |
| 30 Orange | 87 | 112 | 134 | 129 | 173 |
| 31 Placer | 421 | 449 | 655 | 531 | 671 |
| 32 Plumas | 1,461 | 1,820 | 2,255 | 1,671 | 2,285 |
| 33 Riverside | 390 | 380 | 406 | 658 | 354 |
| 34 Sacramento | 6 | 16 | 18 | 18 | 21 |
| 35 San Benito | 405 | 861 | 1,217 | 1,174 | 1,408 |
| 36 San Bernardino | 247 | 210 | 285 | 628 | 455 |
| 37 San Diego | 429 | 767 | 734 | 719 | 792 |
| 38 San Francisco | | | | | |
| 39 San Joaquin | 23 | 23 | 54 | 43 | 60 |
| 40 San Luis Obispo | 623 | 1,103 | 1,389 | 1,115 | 1,503 |
| 41 San Mateo | 108 | 144 | 135 | 167 | 139 |
| 42 Santa Barbara | 650 | 651 | 815 | 708 | 994 |
| 43 Santa Clara | 590 | 763 | 939 | 1,051 | 1,172 |
| 44 Santa Cruz | 111 | 106 | 101 | 118 | 166 |
| 45 Shasta | 993 | 2,154 | 2,880 | 1,940 | 2,566 |
| 46 Sierra | 625 | 947 | 1,126 | 795 | 1,032 |
| 47 Siskiyou | 1,703 | 2,845 | 4,034 | 2,187 | 2,768 |
| 48 Solano | 67 | 102 | 78 | 126 | 113 |
| 49 Sonoma | 871 | 1,138 | 1,447 | 1,553 | 1,679 |
| 50 Stanislaus | 136 | 221 | 311 | 371 | 471 |
| 51 Sutter | 1 | 5 | 4 | 2 | |
| 52 Tehama | 1,241 | 2,060 | 3,710 | 1,623 | 2,932 |
| 53 Trinity | 875 | 1,398 | 1,119 | 1,045 | 1,220 |
| 54 Tulare | 1,169 | 889 | 985 | 1,087 | 1,174 |
| 55 Tuolumne | 601 | 569 | 998 | 956 | 1,447 |
| 56 Ventura | 566 | 728 | 673 | 856 | 784 |
| 57 Yolo | 234 | 269 | 264 | 334 | 349 |
| 58 Yuba | 86 | 171 | 257 | 167 | 244 |
| Not given | 3 | | | | 200 |
| State-wide totals | 32,647 | 47,128 | 64,619 | 50,667 | 59,004 |

TABLE 25

## NUMBER OF MOUNTAIN LIONS BOUNTIED BY DEPARTMENT OF FISH AND GAME

| County | Total bountied 1907-50 | Yearly average 1906-50 | Number bountied annually | | | |
|---|---|---|---|---|---|---|
| | | | 1951 | 1952 | 1953 | Total |
| Alameda | 29 | 1 | 4 | 4 | 2 | 39 |
| Alpine | 3 | | | | 2 | 5 |
| Amador | 27 | 1 | | | | 27 |
| Butte | 78 | 2 | 2 | 2 | 2 | 84 |
| Calaveras | 62 | 1 | | | | 62 |
| Colusa | 86 | 2 | | 6 | | 92 |
| Contra Costa | 1 | | | | 1 | 2 |
| Del Norte | 221 | 5 | | | 1 | 222 |
| El Dorado | 234 | 5 | | 2 | 1 | 237 |
| Fresno | 189 | 4 | 8 | 12 | 6 | 215 |
| Glenn | 268 | 6 | 2 | 6 | 1 | 277 |
| Humboldt | 1,085 | 25 | 8 | 4 | 6 | 1,103 |
| Imperial | 2 | | | | | 2 |
| Inyo | 25 | 1 | 1 | | | 26 |
| Kern | 467 | 11 | 7 | 7 | 10 | 491 |
| Kings | 1 | | | | | 1 |
| Lake | 504 | 11 | 4 | 10 | 3 | 521 |
| Lassen | 13 | | | 1 | | 14 |
| Los Angeles | 188 | 4 | 6 | 2 | | 196 |
| Madera | 106 | 2 | | 1 | 17 | 124 |
| Marin | 3 | | | | | 3 |
| Mariposa | 151 | 3 | | 6 | 2 | 159 |
| Mendocino | 708 | 16 | 7 | 5 | 6 | 726 |
| Merced | 10 | | | | | 10 |
| Modoc | 6 | | | | | 6 |
| Mono | 38 | 1 | 2 | 13 | | 53 |
| Monterey | 682 | 16 | 24 | 6 | 12 | 724 |
| Napa | 4 | | | | | 4 |
| Nevada | 36 | 1 | 1 | 1 | | 38 |
| Orange | 16 | | | | | 16 |
| Placer | 118 | 3 | | 1 | | 119 |
| Plumas | 20 | | | | | 20 |
| Riverside | 108 | 2 | | | 7 | 115 |
| Sacramento | 1 | | | | | 1 |
| San Benito | 68 | 2 | | | 1 | 69 |
| San Bernardino | 176 | 4 | | 2 | | 178 |
| San Diego | 281 | 6 | | 2 | 2 | 285 |
| San Joaquin | 2 | | | | 1 | 3 |
| San Luis Obispo | 254 | 6 | 2 | 8 | 7 | 271 |
| San Mateo | 1 | | | | | 1 |
| Santa Barbara | 440 | 10 | 3 | 8 | | 451 |
| Santa Clara | 159 | 4 | 6 | 4 | 7 | 176 |
| Santa Cruz | 4 | | | | | 4 |
| Shasta | 707 | 16 | 9 | 13 | 17 | 746 |
| Sierra | 43 | 1 | | | | 43 |
| Siskiyou | 549 | 12 | 7 | 11 | 15 | 582 |
| Solano | | | | | | |
| Sonoma | 36 | 1 | | | | 36 |
| Stanislaus | 24 | 1 | 2 | | 2 | 28 |
| Sutter | 1 | | | | | 1 |
| Tehama | 445 | 10 | 5 | 2 | 5 | 457 |
| Trinity | 968 | 22 | 7 | 14 | 10 | 999 |
| Tulare | 510 | 12 | 11 | 12 | 21 | 554 |
| Tuolumne | 185 | 4 | | 2 | | 187 |
| Ventura | 167 | 4 | 4 | 7 | 14 | 192 |
| Yolo | 3 | | | | | 3 |
| Yuba | 45 | 1 | 1 | | | 46 |
| Totals | 10,558 | 239 | 133 | 174 | 181 | 11,046 |

TABLE 26

## PREDATORY ANIMAL CATCH BY COUNTIES

| County | January 1-December 31, 1952 | | | | January 1-December 31, 1953 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Coyote | Bobcat | Other predators | Total | Coyote | Bobcat | Other predators | Total | Total for period |
| Alpine | 13 | 5 | 6 | 24 | | | | | 24 |
| Amador | 21 | 2 | 185 | 208 | 18 | 2 | 83 | 103 | 311 |
| Butte | 57 | 5 | 314 | 376 | 79 | 2 | 1,052 | 1,133 | 1,509 |
| Calaveras | | | | | 19 | 12 | 36 | 67 | 67 |
| Colusa | 8 | 6 | 3 | 17 | | | | | 17 |
| El Dorado | | | | | 12 | 1 | 41 | 54 | 54 |
| Fresno | 47 | 47 | 65 | 159 | 76 | 26 | 71 | 173 | 332 |
| Humboldt | 1 | 36 | 73 | 110 | 35 | 26 | 25 | 86 | 196 |
| Inyo | 119 | 42 | 97 | 258 | 62 | 18 | 67 | 147 | 405 |
| Kern | 79 | 32 | 31 | 142 | 84 | 13 | 4 | 101 | 243 |
| Lake | 31 | 4 | 134 | 169 | 11 | 16 | 81 | 108 | 277 |
| Lassen | 55 | 5 | 19 | 79 | 88 | 40 | 85 | 213 | 292 |
| Los Angeles | 47 | 56 | 75 | 178 | 57 | 41 | 73 | 171 | 349 |
| Madera | 27 | 4 | 24 | 55 | 52 | 3 | 46 | 101 | 156 |
| Mariposa | 23 | 10 | 185 | 218 | 16 | 3 | 93 | 112 | 330 |
| Merced | 13 | 1 | 64 | 78 | | | 87 | 87 | 165 |
| Modoc | 95 | 16 | 40 | 151 | | | | | 151 |
| Monterey | 20 | 87 | 412 | 519 | 20 | 29 | 239 | 288 | 807 |
| Nevada | 3 | 6 | 33 | 42 | 15 | 3 | 40 | 58 | 100 |
| Plumas | 79 | 16 | 5 | 100 | 229 | 92 | 168 | 489 | 589 |
| Riverside | 64 | 65 | 325 | 454 | 68 | 70 | 234 | 372 | 826 |
| Sacramento | 31 | 2 | 209 | 242 | | | 135 | 135 | 377 |
| San Benito | 6 | 62 | 178 | 246 | 9 | 86 | 278 | 373 | 619 |
| San Bernardino | 168 | 79 | 94 | 341 | 66 | 87 | 97 | 250 | 591 |
| San Diego | 136 | 39 | 72 | 247 | 68 | 29 | 66 | 163 | 410 |
| San Joaquin | | | | | | | 34 | 34 | 34 |
| San Luis Obispo | 64 | 107 | 131 | 302 | 51 | 114 | 363 | 528 | 830 |
| Santa Barbara | | 2 | 2 | 4 | 11 | 9 | 14 | 34 | 38 |
| Santa Clara | 44 | 68 | 172 | 284 | | | | | 284 |
| Shasta | 149 | 29 | 169 | 347 | 206 | 51 | 296 | 553 | 900 |
| Sierra | 15 | 6 | 2 | 23 | | | | | 23 |
| Siskiyou | 243 | 59 | 46 | 348 | 225 | 70 | 57 | 352 | 700 |
| Solano | | | 123 | 123 | | | 239 | 239 | 362 |
| Sutter | 34 | 8 | 98 | 140 | | | 65 | 65 | 205 |
| Tehama | 19 | 10 | 23 | 52 | 7 | | 23 | 30 | 82 |
| Trinity | 60 | 7 | 63 | 130 | 23 | 4 | 57 | 84 | 214 |
| Tulare | 12 | 35 | 51 | 98 | | 2 | | 2 | 100 |
| Tuolumne | 73 | 19 | 55 | 147 | 52 | 12 | 42 | 106 | 253 |
| Ventura | 58 | 39 | 60 | 157 | 40 | 23 | 49 | 112 | 269 |
| Yuba | 58 | 10 | 225 | 293 | 108 | 35 | 482 | 625 | 918 |
| Totals | 1,972 | 1,026 | 3,863 | 6,861 | 1,807 | 919 | 4,822 | 7,548 | 14,409 |

| | January 1-December 31, 1952 | January 1-December 31, 1953 |
|---|---|---|
| Average number trappers | 34 | 29 |
| Number of sets | 292,057 | 245,209 |
| Number of days | 6,916 | 5,893 |

TABLE 27

## PREDATORY BIRD BOUNTIES PAID BY THE DEPARTMENT

| County | Number bountied | | | |
|---|---|---|---|---|
| | Crows | | Magpies | |
| | 1952 | 1953 | 1952 | 1953 |
| Colusa | 127 | | | |
| Contra Costa | 178 | 189 | | |
| Lassen | 75 | | 191 | |
| Orange | 184 | | | |
| San Joaquin | 64 | | | |
| Santa Barbara | 227 | | | |
| Shasta | | 2 | | |
| Ventura | 360 | | | |
| Yolo | 275 | | | |
| Totals | 1,490 | 191 | 191 | |

TABLE 28

## SUMMARY OF DEPARTMENT OF FISH AND GAME LANDS, 1954

(Game Management)

| Area | Acreage | Purchase price |
|---|---|---|
| Los Banos Waterfowl Refuge | 3,000.00 | $104,241.40 |
| Grey Lodge Waterfowl Refuge | 2,541.51 | 133,417.00 |
| Suisun Waterfowl Refuge | 1,887.00 | 71,875.50 |
| Imperial Waterfowl Refuge | 2,064.43 | 88,405.05 |
| Imperial Waterfowl Management Area | *4,415.24 | 47,775.52 |
| Honey Lake Waterfowl Management Area | 4,819.70 | 90,784.09 |
| Madeline Plains Waterfowl Management Area | 5,176.10 | 47,353.20 |
| Grizzly Island Waterfowl Management Area | 8,600.00 | 650,000.00 |
| Tehama Winter Deer Range | 42,896.90 | 212,518.86 |
| Doyle Winter Deer Range | 13,502.91 | 37,807.76 |
| Totals | 88,903.79 | $1,484,178.38 |

*Includes 3,880 acres of leased land.

| Use or type | Acres | Purchase price |
|---|---|---|
| Deer ranges | 56,399.81 | $250,326.62 |
| Waterfowl areas | 32,503.98 | 1,233,851.76 |
| Totals | 88,903.79 | $1,484,178.38 |

### STATE-OWNED GAME FARMS

| Name | Acres | Capacity, birds |
|---|---|---|
| Chico | 12 | 4,000 |
| Los Serranos | 29 | 9,000 |
| Marysville | 11 | 4,500 |
| Redding | 14 | 5,000 |
| Yountville | 72 | 5,000 |
| Brawley (part of Imperial Refuge) | | 9,000 |
| Total state owned game farms | 138.00 | |
| Total deer ranges and waterfowl areas | 87,530.03 | |
| Total acreage | 87,668.03 | |

TABLE 29

## GAME BIRD RELEASES

Liberation of Game Farm Birds, January 1, 1952, Through December 31, 1953

| County | Ring-neck | Reeves | Chukar | Total |
|---|---|---|---|---|
| Alameda | 879 | | | 879 |
| Amador | 1,209 | | | 1,209 |
| Butte | 9,707 | 523 | | 10,230 |
| Colusa | 5,351 | | | 5,351 |
| Contra Costa | 2,513 | | | 2,513 |
| Del Norte | | 240 | | 240 |
| Fresno | 9,313 | | | 9,313 |
| Glenn | 3,069 | | | 3,069 |
| Humboldt | 675 | | | 675 |
| Imperial | 16,278 | | | 16,278 |
| Inyo | 7,917 | | | 7,917 |
| Kern | 8,061 | | | 8,061 |
| Kings | 634 | | | 634 |
| Lassen | 2,335 | | | 2,335 |
| Los Angeles | 6,544 | | 15 | 6,559 |
| Madera | 1,944 | 180 | | 2,124 |
| Mendocino | 200 | | | 200 |
| Merced | 11,052 | | | 11,052 |
| Modoc | 2,677 | | | 2,677 |
| Mono | 420 | | | 420 |
| Monterey | 3,854 | 100 | | 3,954 |
| Napa | 1,863 | | | 1,863 |
| Nevada | 400 | | | 400 |
| Orange | 110 | | 112 | 222 |
| Placer | 1,743 | | | 1,743 |
| Riverside | 5,625 | | 200 | 5,825 |
| Sacramento | 11,973 | | | 11,973 |
| San Bernardino | 2,627 | | 1,800 | 4,427 |
| San Diego | 4,450 | | 205 | 4,655 |
| San Joaquin | 13,588 | | | 13,588 |
| San Luis Obispo | 200 | | | 200 |
| Santa Barbara | 200 | | | 200 |
| Santa Clara | 50 | | | 50 |
| Shasta | 3,478 | | | 3,478 |
| Siskiyou | 4,122 | | | 4,122 |
| Solano | 9,450 | | | 9,450 |
| Sonoma | 4,251 | 912 | | 5,163 |
| Stanislaus | 2,845 | | | 2,845 |
| Sutter | 6,404 | | | 6,404 |
| Tehama | 2,146 | | | 2,146 |
| Tulare | 7,315 | | | 7,315 |
| Ventura | 300 | | | 300 |
| Yolo | 6,632 | | | 6,632 |
| Yuba | 2,981 | | | 2,981 |
| Republic of Mexico | 100 | | | 100 |
| Totals | 187,485 | 1,955 | 2,332 | 191,772 |

TABLE 30

## WATERFOWL MANAGEMENT AREA OPERATIONS

| Area | Acreage open to hunting | | Scheduled seasonal shooter capacity | | Actual number hunters using area[2] | | Number of waterfowl bagged | | Average bag per hunter | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 |
| Madeline Plains | 2,400 | 2,400 | 8,400 | 7,680 | 473 | 1,064 | 897 | 1,655 | 1.9 | 1.6 |
| Honey Lake | 3,000 | 2,500 | 5,250 | 4,800 | 3,677 | 2,912 | 3,756 | 2,196 | 1.0 | 0.8 |
| Gray Lodge | | 1,200 | | 1,760 | | 2,113 | | 8,549 | | 4.0 |
| Colusa | 1,100 | 1,100 | 2,160 | 1,760 | 3,350 | 2,566 | 6,832 | 7,786 | 2.0 | 3.0 |
| Sutter | | 1,000 | | 1,650 | | 2,386 | | 9,561 | | 4.0 |
| Grizzly Island | 4,500 | 5,000 | 14,000 | 15,200 | 16,047 | 11,936 | 44,126 | 41,218 | 2.8 | 3.5 |
| San Luis Wasteway | 1,500 | 1,500 | 3,500 | 3,200 | 3,740 | 3,579 | 6,881 | 8,314 | 1.8 | 2.3 |
| Merced | 1,200 | 1,000 | 2,400 | 1,920 | 1,180 | 1,194 | 1,717 | 2,255 | 1.5 | 1.9 |
| Los Banos | | 1,070 | | 2,400 | | 1,736 | | 3,070 | | 1.8 |
| Imperial[1] | 3,525 | 2,325 | 22,200 | 9,900 | 5,904 | 4,801 | 14,586 | 10,475 | 2.5 | 2.2 |
| Welch Co-op | | 5,680 | | 8,800 | | 3,047 | | 3,122 | | 1.0 |
| Totals | 17,225 | 24,775 | 57,910 | 59,070 | 34,371 | 37,334 | 78,795 | 98,201 | 2.3 | 2.6 |

[1] Includes Hazard, Pumice, Poe and Federal Units.
[2] Actual number of hunters using area may exceed schedule capacity because of hunters going on areas late in day after original hunters leave area.

TABLE 31

## COOPERATIVE PHEASANT HUNTING AREA OPERATIONS

| Area | Acreage open to hunting | | Scheduled seasonal shooter capacity* | | Actual number hunters using area | | Number of pheasants bagged | | Percent of successful hunters† | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 | 1952 | 1953 |
| Staten Island | 8,090 | 9,300 | 5,400 | 6,200 | 4,008 | 4,386 | 1,479 | 1,715 | 36 | 39 |
| Ryer Island | 10,500 | 10,800 | 6,600 | 7,200 | 3,719 | 4,172 | 1,365 | 1,725 | 37 | 40 |
| Sutter Basin | 14,000 | 10,600 | 14,000 | 10,600 | 6,218 | 5,286 | 2,237 | 2,741 | 37 | 51 |
| Natomas | 11,500 | 11,465 | 11,500 | 11,500 | 9,806 | 8,700 | 2,759 | 3,200 | 28 | 37 |
| Grimes | 15,000 | 17,000 | 15,000 | 17,000 | 7,575 | 4,006 | 3,522 | 3,013 | 47 | 75 |
| College City | | 4,200 | | 4,200 | | 3,099 | | 1,433 | | 46 |
| Sartain | 11,000 | | 11,000 | | 2,687 | | 1,408 | | 56 | |
| Butte Creek | 9,000 | 4,462 | 9,000 | 4,500 | 4,576 | 2,686 | 1,136 | 965 | 25 | 32 |
| Meridian | 8,718 | 6,312 | 5,810 | 4,200 | 2,826 | 2,530 | 1,287 | 1,331 | 48 | 52 |
| Los Banos | 5,110 | | 2,500 | | 3,091 | | 1,190 | | 39 | |
| Merced | | 8,000 | | 4,000 | | 5,684 | | 2,420 | | 46 |
| Firebaugh | 8,000 | 10,000 | 5,000 | 5,000 | 4,314 | 5,325 | 1,924 | 2,117 | 45 | 39 |
| Twitchell Island | 5,880 | 5,880 | 3,670 | 2,940 | 3,557 | 4,016 | 929 | 915 | 26 | 23 |
| Tyler Island | 6,716 | 5,800 | 4,290 | 3,870 | 2,917 | 4,040 | 1,307 | 1,810 | 46 | 44 |
| Union Island | 8,200 | 9,600 | 4,000 | 4,800 | 2,796 | 3,687 | 619 | 1,019 | 22 | 27 |
| Yolo | 8,520 | 9,000 | 4,140 | 6,000 | 3,674 | 4,673 | 958 | 1,870 | 23 | 40 |
| McArthur | 5,660 | 5,000 | 5,660 | 5,000 | 1,576 | 1,881 | 711 | 1,366 | 45 | 72 |
| Plainfield | | 6,200 | | 6,200 | | 5,492 | | 2,128 | | 39 |
| Courtland | | 3,200 | | 2,150 | | 2,666 | | 799 | | 30 |
| Welch | | 5,680 | | 5,500 | | 512 | | 131 | | 26 |
| Totals | 135,894 | 142,499 | 107,570 | 110,860 | 63,340 | 72,841 | 22,831 | 30,698 | 36 | 42 |

*Minimum number of hunters that could be accommodated for the season.
No correction is made for hunters that hunt only part of a day and are then replaced by other hunters.
†Derived by dividing the number of pheasants shot by the number of hunters.
No correction is made for hunters shooting two pheasants (the daily limit).

TABLE 32

## GAME FARM UNITS AND YEARLY CAPACITY

| Game farm | County | Yearly capacity |
|---|---|---|
| Redding | Shasta | 5,000 |
| Chico | Butte | 4,000 |
| Marysville | Yuba | |
| Sacramento | Sacramento | 10,000 |
| Stockton | San Joaquin | 2,400 |
| Yountville | Napa | 15,000 |
| Kern | Kern | 4,000 |
| Fresno | Fresno | 7,000 |
| Los Banos | Merced | 4,000 |
| Porterville | Tulare | 5,000 |
| Brawley | Imperial | 9,000 |
| Castaic | Los Angeles | 3,000 |
| Los Serranos | San Bernardino | 9,000 |
| Valley Center | San Diego | 2,000 |
| Total | | 80,400 |

TABLE 33

## ABALONE LANDINGS, CALIFORNIA

| Year | Pounds |
|---|---|
| 1948 | 3,228,927 |
| 1949 | 3,599,998 |
| 1950 | 3,954,791 |
| 1951 | 4,084,115 |
| 1952 | 4,784,033 |
| 1953 | 4,719,504 |

TABLE 34

## PACIFIC OYSTER LANDINGS

| | |
|---|---|
| 1933 | 68,762 |
| 1934 | 50,240 |
| 1935 | 299,375 |
| 1936 | 310,683 |
| 1937 | 680,081 |
| 1938 | 1,207,421 |
| 1939 | 1,659,355 |
| 1940 | 1,292,505 |
| 1941 | 1,717,781 |
| 1942 | 609,233 |
| 1943 | 741,105 |
| 1944 | 636,686 |
| 1945 | 309,738 |
| 1946 | 88,006 |
| 1947 | 46,035 |
| 1948 | 166,524 |
| 1949 | 235,134 |
| 1950 | 143,612 |
| 1951 | 133,700 |
| 1952 | 180,141 |
| 1953 | 161,520 |

TABLE 35

## PACIFIC MACKEREL LANDINGS BY SEASONS

| Season | Pounds of fish | Season | Pounds of fish |
|---|---|---|---|
| 1926-27 | 3,593,962 | 1940-41 | 107,553,929 |
| 1927-28 | 6,455,033 | 1941-42 | 71,754,709 |
| 1928-29 | 39,405,114 | 1942-43 | 48,220,187 |
| 1929-30 | 56,694,637 | 1943-44 | 77,853,106 |
| 1930-31 | 12,805,751 | 1944-45 | 80,785,356 |
| 1931-32 | 15,152,465 | 1945-46 | 52,002,734 |
| 1932-33 | 10,850,403 | 1946-47 | 58,896,372 |
| 1933-34 | 72,873,851 | 1947-48 | 39,627,373 |
| 1934-35 | 113,464,209 | 1948-49 | 38,202,903 |
| 1935-36 | 146,387,327 | 1949-50 | 50,061,684 |
| 1936-37 | 100,745,270 | 1950-51 | 33,890,004 |
| 1937-38 | 70,445,621 | 1951-52 | 31,904,919 |
| 1938-39 | 76,064,647 | 1952-53 | 18,761,833 |
| 1939-40 | 99,960,747 | 1953-54 | 7,612,679 |

TABLE 36

## CALIFORNIA JACK MACKEREL LANDINGS BY SEASONS

| Season | Pounds of fish | Season | Pounds of fish |
|---|---|---|---|
| 1926-27 | 365,245 | 1940-41 | 1,749,646 |
| 1927-28 | 425,197 | 1941-42 | 1,917,129 |
| 1928-29 | 556,550 | 1942-43 | 9,794,416 |
| 1929-30 | 673,936 | 1943-44 | 8,454,883 |
| 1930-31 | 310,894 | 1944-45 | 13,742,894 |
| 1931-32 | 672,679 | 1945-46 | 9,280,072 |
| 1932-33 | 465,351 | 1946-47 | 31,146,258 |
| 1933-34 | 1,106,317 | 1947-48 | 142,660,570 |
| 1934-35 | 1,653,549 | 1948-49 | 55,690,542 |
| 1935-36 | 9,849,115 | 1949-50 | 64,987,587 |
| 1936-37 | 5,757,158 | 1950-51 | 136,374,757 |
| 1937-38 | 8,242,112 | 1951-52 | 74,990,835 |
| 1938-39 | 3,925,278 | 1952-53 | 151,470,361 |
| 1939-40 | 1,117,895 | 1953-54 | 35,061,944 |

TABLE 37

## SEASONAL CATCH IN TONS * OF SARDINES ALONG THE PACIFIC COAST—EACH SEASON INCLUDES JUNE THROUGH THE FOLLOWING MAY

| Season | British Columbia | Washington | Oregon | Total Pacific northwest | California | | | | | | Grand total | California percent of total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Floating plants | San Francisco | Monterey | San Pedro | San Diego | Total California | | |
| 1916-17 | | | | | | | 7,710 | 17,380 | 2,440 | 27,530 | 27,530 | 100 |
| 1917-18 | 80 | | | 80 | | 70 | 23,810 | 41,340 | 7,360 | 72,580 | 72,660 | 100 |
| 1918-19 | 3,640 | | | 3,640 | | 450 | 35,750 | 32,530 | 6,810 | 75,540 | 79,180 | 95 |
| 1919-20 | 3,280 | | | 3,280 | | 1,000 | 43,040 | 16,580 | 6,410 | 67,030 | 70,310 | 95 |
| 1920-21 | 4,400 | | | 4,400 | | 230 | 24,960 | 11,740 | 1,520 | 38,450 | 42,850 | 90 |
| 1921-22 | 990 | | | 990 | | 80 | 16,290 | 19,220 | 910 | 36,500 | 37,490 | 97 |
| 1922-23 | 1,020 | | | 1,020 | | 110 | 29,210 | 33,170 | 2,620 | 65,110 | 66,130 | 98 |
| 1923-24 | 970 | | | 970 | | 190 | 45,920 | 35,040 | 2,780 | 83,930 | 84,900 | 99 |
| 1924-25 | 1,370 | | | 1,370 | | 560 | 67,310 | 96,330 | 8,820 | 173,020 | 174,390 | 99 |
| 1925-26 | 15,950 | | | 15,950 | | 560 | 69,010 | 61,990 | 5,710 | 137,270 | 153,220 | 90 |
| 1926-27 | 48,500 | | | 48,500 | | 3,520 | 81,860 | 64,720 | 2,110 | 152,210 | 200,710 | 76 |
| 1927-28 | 68,430 | | | 68,430 | | 16,690 | 98,020 | 67,900 | 4,650 | 187,260 | 255,690 | 73 |
| 1928-29 | 80,510 | | | 80,510 | | 13,520 | 120,290 | 119,250 | 1,420 | 254,480 | 334,990 | 76 |
| 1929-30 | 86,340 | | | 86,340 | | 21,960 | 160,050 | 140,540 | 2,620 | 325,170 | 411,510 | 79 |
| 1930-31 | 75,070 | | | 75,070 | 10,960 | 25,970 | 109,620 | 38,490 | 80 | 185,120 | 260,190 | 71 |
| 1931-32 | 73,600 | | | 73,600 | 31,040 | 21,610 | 69,080 | 42,660 | 260 | 164,650 | 238,250 | 69 |
| 1932-33 | 44,350 | | | 44,350 | 58,790 | 18,630 | 89,600 | 83,600 | 60 | 250,680 | 295,030 | 85 |
| 1933-34 | 4,050 | | | 4,050 | 67,820 | 36,340 | 152,480 | 125,050 | 1,750 | 383,440 | 387,490 | 99 |
| 1934-35 | 43,000 | | | 43,000 | 112,040 | 69,000 | 230,860 | 178,820 | 4,860 | 595,580 | 638,580 | 93 |
| 1935-36 | 45,320 | 10 | 26,230 | 71,560 | 150,830 | 76,150 | 184,470 | 138,400 | 10,650 | 560,500 | 632,060 | 89 |
| 1936-37 | 44,450 | 6,560 | 14,200 | 65,210 | 235,610 | 141,100 | 206,710 | 138,110 | 4,590 | 726,120 | 791,330 | 92 |
| 1937-38 | 48,080 | 17,100 | 16,660 | 81,840 | 67,580 | 133,720 | 104,930 | 109,950 | 380 | 416,560 | 498,400 | 84 |
| 1938-39 | 51,770 | 26,480 | 17,020 | 95,270 | 43,890 | 201,200 | 180,990 | 146,400 | 2,780 | 575,260 | 670,530 | 86 |
| 1939-40 | 5,520 | 17,760 | 22,330 | 45,610 | | 212,450 | 227,870 | 101,820 | 110 | 542,250 | 587,860 | 92 |
| 1940-41 | 28,770 | 810 | 3,160 | 32,740 | | 118,090 | 165,700 | 175,590 | 1,200 | 460,580 | 493,320 | 93 |
| 1941-42 | 60,050 | 17,100 | 15,850 | 93,000 | | 186,590 | 250,290 | 148,910 | 1,580 | 587,370 | 680,370 | 86 |
| 1942-43 | 65,880 | 580 | 1,950 | 68,410 | | 115,880 | 184,400 | 201,510 | 2,870 | 504,660 | 573,070 | 88 |
| 1943-44 | 88,740 | 10,440 | 1,820 | 101,000 | | 126,510 | 213,620 | 135,310 | 2,690 | 478,130 | 579,130 | 83 |
| 1944-45 | 59,120 | 20 | | 59,140 | | 136,600 | 237,250 | 178,290 | 2,770 | 554,910 | 614,050 | 90 |
| 1945-46 | 34,300 | 2,310 | 90 | 36,700 | | 84,100 | 145,520 | 173,110 | 950 | 403,680 | 440,380 | 92 |
| 1946-47 | 3,990 | 6,140 | 3,960 | 14,090 | | 2,870 | 31,240 | 194,720 | 4,770 | 233,600 | 247,690 | 94 |
| 1947-48 | 490 | 1,360 | 6,930 | 8,780 | | 90 | 17,630 | 101,150 | 2,460 | 121,330 | 130,110 | 93 |
| 1948-49 | | 50 | 5,320 | 5,370 | | 110 | 47,830 | 131,860 | 3,920 | 183,720 | 189,090 | 97 |
| 1949-50 | | | | | | 16,090 | 130,990 | 187,260 | 3,280 | 337,620 | 337,620 | 100 |
| 1950-51 | | | | | | 12,730 | 19,100 | 318,350 | 2,910 | 353,090 | 353,090 | 100 |
| 1951-52 | | | | | | 80 | 640 | 127,030 | 1,350 | 129,100 | 129,100 | 100 |
| 1952-53 | | | | | | | 10 | 5,680 | 30 | 5,720 | 5,720 | 100 |
| 1953-54 | | | | | | | | 4,140 | 320 | 4,460 | 4,460 | 100 |

*Data for British Columbia were supplied by the Canadian Bureau of Statistics and the Province of British Columbia, those for Washington by the Washington Department of Fisheries and for Oregon by the Fish Commission of Oregon. Tonnages delivered to the floating plants were compiled by the United States Fish and Wildlife Service from the books of the companies operating off the California coast. California landings were derived from the records of the California Department of Fish and Game.

TABLE 38

## POUNDS OF LIVE BAIT TAKEN BY THE VESSELS SUPPLYING THE PARTY BOAT FLEET

| | | | |
|---|---|---|---|
| 1947 | 7,701,000 | 1951 | 13,228,000 |
| 1948 | 9,145,000 | 1952 | 14,365,000 |
| 1949 | 9,065,000 | 1953 | 12,978,000 |
| 1950 | 11,058,000 | | |

TABLE 39

## ALBACORE

| Year | Fishing boat landings | Shipments | Total |
|---|---|---|---|
| 1948 | 36,460,157 | 1,149,632 | 37,609,789 |
| 1949 | 44,006,280 | 284,040 | 44,290,320 |
| 1950 | 61,745,994 | 4,378,420 | 66,124,414 |
| 1951 | 30,915,342 | 17,520,891 | 48,436,233 |
| 1952 | 49,802,791 | 22,525,248 | 72,328,039 |
| 1953 | 33,834,626 | 46,186,816 | 80,021,442 |

TABLE 40

## SALMON MARKING AND RECOVERY,[1] 1950-1954

| Fins removed | Brood year | Where released | Date of release | Origin of eggs or fish | Number released | Ocean recoveries | | | | River recoveries | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | 1951 | 1952 | 1953 | 1954 [2,3] | 1951 | 1952 | 1953 | 1954 [2] |
| KING (captured) | | | | | | | | | | | | | |
| D-LV | 1949 | Sacramento River | Feb.-Mar. 1950 | Sacramento River | 235,248 | 2 | 15 | 19 | ---- | 1 | 6 | 11 | ---- |
| KING (hatchery) | | | | | | | | | | | | | |
| D-RV | 1949 | Battle Creek | March 1950 | Battle Creek | 235,466 | 1 | 488 | 136 | ---- | 41 | 203 | 214 | ---- |
| An-LV | 1949 | Big River, Mendocino Co. | May 1950 | Mad River | 132,734 | ---- | 4 | 8 | ---- | ---- | ---- | ---- | ---- |
| LV | 1950 | Mad River | July-Aug. 1951 | Mad River | 75,826 | ---- | ---- | ---- | ---- | ---- | 1 | ---- | ---- |
| D-Ad | 1951 | Battle Creek | March 1952 | Battle Creek | 505,933 | ---- | ---- | ---- | 3 | ---- | ---- | 4 | ---- |
| Ad-LV | 1951 | Klamath R. near mouth | April 1952 | Klamath River | 199,730 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Ad-RV | 1951 | Klamath R. above Highway 99 | May 1952 | Klamath River | 202,778 | ---- | ---- | ---- | 4 | ---- | ---- | ---- | ---- |
| Ad-An | 1951 | Mad River | June 1952 | Mad River | 99,300 | ---- | ---- | ---- | 1 | ---- | ---- | ---- | ---- |
| D-Ad-LV | 1951 | Battle Creek | Sept. 1952 | Battle Creek | 41,850 | ---- | ---- | ---- | 1 | ---- | ---- | 1 | ---- |
| D-Ad-RV | 1952 | Mad River | Dec. 1953 | Mad River | 12,100 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| SILVER (captured) | | | | | | | | | | | | | |
| Ad-LV-RV | 1949 | Del Norte and Humboldt Co. | May-July 1951 | Del Norte and Humboldt Co. | 1,772 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Ad-RV | 1950 | Del Norte and Humboldt Co. | May-July 1951 | Del Norte and Humboldt Co. | 164,423 | ---- | ---- | 3 | ---- | ---- | ---- | 29 | ---- |
| | | | | | 1,907,160 | 3 | 507 | 166 | 9 | 42 | 210 | 259 | ---- |

[1]Actual number of recoveries not weighted by sampling efficiency. Ocean recoveries include those taken off British Columbia, Washington, Oregon, and California in random samples only. River recoveries include those made by spawning area survey crews and hatchery personnel.
[2]1954 recoveries incomplete.
[3]Through June 30, 1954—California ocean recoveries only.

TABLE 41

## BLUEFIN TUNA

| Year | Fishing boat landings | Shipments | Total |
|---|---|---|---|
| 1948 | 6,528,807 | 168,180 | 6,696,987 |
| 1949 | 4,389,390 | ---- | 4,389,390 |
| 1950 | 2,738,963 | 107,878 | 2,846,841 |
| 1951 | 3,862,394 | 2,112 | 3,864,506 |
| 1952 | 4,576,685 | ---- | 4,576,685 |
| 1953 | 9,772,855 | 62,447 | 9,835,302 |

TABLE 42

## YELLOWFIN TUNA

| Year | Fishing boat landings | Shipments | Total |
|---|---|---|---|
| 1948 | 191,723,801 | ---- | 191,723,801 |
| 1949 | 184,972,285 | 639,809 | 185,612,094 |
| 1950 | 182,315,834 | 8,130,632 | 190,446,466 |
| 1951 | 160,246,175 | 13,422,415 | 173,668,590 |
| 1952 | 178,437,493 | 7,080,197 | 185,517,690 |
| 1953 | 132,086,346 | 8,458,606 | 140,544,952 |

TABLE 43

## BIGEYE TUNA AND BLACK SKIPJACK

| Year | Fishing boat landings | Shipments |
|---|---|---|
| 1948 | ---- | ---- |
| 1949 | ---- | ---- |
| 1950 | ---- | [1]40,000 |
| 1951 | [2]7,240 | [2]30,000 |
| 1952 | ---- | ---- |
| 1953 | [3]4,215 | [2]20,000 |

[1]Reported to be Atlantic skipjack shipment from East Coast.
[2]Bigeye tuna.
[3]Black skipjack.

TABLE 44

## SKIPJACK

| Year | Fishing boat landings | Shipments | Total |
|---|---|---|---|
| 1948 | 58,770,706 | 1,364 | 58,772,070 |
| 1949 | 78,521,918 | 52,739 | 78,574,657 |
| 1950 | 124,779,419 | 3,261,659 | 128,041,078 |
| 1951 | 115,886,848 | 2,750,824 | 118,637,672 |
| 1952 | 84,736,126 | 4,155,541 | 88,891,667 |
| 1953 | 122,306,183 | 8,347,736 | 130,653,919 |

TABLE 45

## YEARLY LANDINGS IN POUNDS

Salmon [1]

| Year | Ocean caught | Sacramento-San Joaquin Rivers | Other rivers[2] | Total pounds |
|---|---|---|---|---|
| 1916 | 5,592,216 | 3,450,787 | 1,896,591 | 10,939,594 |
| 1917 | 6,085,997 | 3,975,487 | 999,097 | 11,060,581 |
| 1918 | 5,933,346 | 5,938,029 | 1,221,813 | 13,093,188 |
| 1919 | 7,208,382 | 4,529,222 | 1,408,123 | 13,145,727 |
| 1920 | 6,066,190 | 3,860,312 | 1,207,317 | 11,133,819 |
| 1921 | 4,483,105 | 2,511,127 | 996,700 | 7,990,932 |
| 1922 | 4,338,317 | 1,765,066 | 1,131,741 | 7,235,124 |
| 1923 | 3,736,924 | 2,243,945 | 1,109,391 | 7,090,260 |
| 1924 | 6,374,573 | 2,640,110 | 1,000,586 | 10,015,269 |
| 1925 | 5,481,536 | 2,778,846 | 1,265,371 | 9,525,753 |
| 1926 | 3,863,677 | 1,261,776 | 958,626 | 6,084,079 |
| 1927 | 4,921,600 | 920,786 | 669,543 | 6,511,929 |
| 1928 | 3,444,306 | 553,777 | 480,483 | 4,478,566 |
| 1929 | 4,033,660 | 581,497 | 429,714 | 5,044,871 |
| 1930 | 4,085,650 | 1,213,698 | 703,546 | 6,002,894 |
| 1931 | 3,666,841 | 941,605 | 686,065 | 5,294,511 |
| 1932 | 2,649,194 | 1,264,987 | 703,990 | 4,618,171 |
| 1933 | 3,657,661 | 454,253 | 446,520 | 4,558,434 |
| 1934 | 3,921,530 | 397,572 | | 4,319,102 |
| 1935 | 4,773,112 | 888,868 | | 5,661,980 |
| 1936 | 4,093,475 | 949,179 | | 5,042,654 |
| 1937 | 5,934,996 | 974,871 | | 6,909,867 |
| 1938 | 2,170,921 | 1,668,376 | | 3,839,297 |
| 1939 | 2,238,755 | 496,933 | | 2,735,688 |
| 1940 | 5,160,403 | 1,515,588 | | 6,675,991 |
| 1941 | 2,945,994 | 844,963 | | 3,790,957 |
| 1942 | 4,063,306 | 2,552,944 | | 6,616,250 |
| 1943 | 5,285,527 | 1,295,424 | | 6,580,951 |
| 1944 | 7,021,848 | 3,265,143 | | 10,286,991 |
| 1945 | 7,912,754 | 5,467,960 | | 13,380,714 |
| 1946 | 7,134,472 | 6,524,991 | | 13,659,463 |
| 1947 | 8,080,780 | 3,403,808 | | 11,484,588 |
| 1948 | 5,829,377 | 1,932,493 | | 7,761,870 |
| 1949 | 5,530,674 | 898,364 | | 6,429,038 |
| 1950 | 5,856,850 | 1,150,313 | | 7,007,163 |
| 1951 | 5,840,984 | 1,243,395 | | 7,084,379 |
| 1952 | 6,500,390 | 702,352 | | 7,202,742 |
| 1953 | 6,973,227 | 865,723 | | 7,838,950 |

The commercial catch of king and silver salmon in California has not been separated. Occasional samples and partial separation for a few areas are available for a few years. The recent samples indicate that the silver salmon constituted about 9 percent by weight of the ocean catch in 1939-1942. Silver salmon are not taken by the Sacramento-San Joaquin fishery.

[2] Eel, Klamath, Mad and Smith Rivers were closed to commercial fishing in 1934.

TABLE 46

## ANCHOVY LANDINGS, 1916-1953, INCLUSIVE

| Year | Pounds | | |
|---|---|---|---|
| | Commercial | Live bait | Comm. and live bait |
| 1916 | 531,209 | | |
| 1917 | 528,753 | | |
| 1918 | 868,161 | | |
| 1919 | 1,609,548 | | |
| 1920 | 569,774 | | |
| 1921 | 1,946,881 | | |
| 1922 | 652,516 | | |
| 1923 | 307,074 | | |
| 1924 | 346,951 | | |
| 1925 | 93,071 | | |
| 1926 | 60,157 | | |
| 1927 | 368,201 | | |
| 1928 | 357,470 | | |
| 1929 | 382,445 | | |
| 1930 | 319,561 | | |
| 1931 | 307,494 | | |
| 1932 | 299,217 | | |
| 1933 | 317,292 | | |
| 1934 | 257,505 | | |
| 1935 | 178,970 | | |
| 1936 | 195,122 | | |
| 1937 | 226,229 | | |
| 1938 | 735,144 | | |
| 1939 | 2,147,901 | | |
| 1940 | 6,317,797 | | |
| 1941 | 4,105,382 | | |
| 1942 | 1,694,290 | | |
| 1943 | 1,570,803 | | |
| 1944 | 3,891,029 | | |
| 1945 | 1,616,880 | | |
| 1946 | 1,921,627 | | |
| 1947 | 18,940,521 | | |
| 1948 | 10,835,930 | 7,450,993 | 18,286,923 |
| 1949 | 3,322,273 | 5,604,735 | 8,927,008 |
| 1950 | 4,878,687 | 7,647,640 | 12,526,327 |
| 1951 | 6,954,852 | 10,283,730 | 17,238,582 |
| 1952 | 55,782,870 | 13,620,879 | 69,403,749 |
| 1953 | 84,503,703 | 12,783,016 | 97,286,719 |

TABLE 47

## COMMERCIAL FISHING FLEET

| Homeport | 1952-1953 | 1953-1954 |
|---|---|---|
| Eureka | 465 | 476 |
| Sacramento | 277 | 240 |
| San Francisco | 789 | 764 |
| Monterey | 447 | 440 |
| Santa Barbara | 244 | 249 |
| Los Angeles | 2,016 | 1,863 |
| San Diego | 807 | 792 |
| Alaska, Washington, Oregon | 405 | 433 |
| Other registry | 4 | 3 |
| Total number of boats | 5,454 | 5,260 |

TABLE 48

## RESIDENCE OF LICENSED COMMERCIAL FISHERMEN

| Region of residence | Number of fishermen, 1952-1953 | Number of fishermen, 1953-1954 |
|---|---|---|
| Eureka | 862 | 835 |
| Sacramento | 413 | 408 |
| San Francisco | 1,281 | 1,216 |
| Monterey | 940 | 936 |
| Santa Barbara | 448 | 467 |
| Los Angeles | 3,808 | 3,598 |
| San Diego | 2,746 | 2,922 |
| Alaska, Washington and Oregon fishermen licensed in California | 983 | 920 |
| Mexican nationals licensed in California | 85 | 66 |
| Total number of fishermen | 11,566 | 11,368 |

TABLE 49

## CALIFORNIA FISHERIES PRODUCTION

| | 1952 | 1953 | Total |
|---|---|---|---|
| Total landings, pounds | 694,978,340 | 617,329,389 | 1,312,307,729 |
| Cases of fish canned | 12,474,885 | 12,358,514 | 24,833,399 |
| Tons of fish meal produced | 33,324 | 25,121 | 58,445 |
| Gallons of fish oil produced | 1,092,992 | 814,221 | 1,907,213 |
| Gallons of liver oil produced | 19,570 | 5,330 | 24,900 |

TABLE 50

## POUNDS AND VALUE [1] OF COMMERCIAL FISH LANDINGS AND SHIPMENTS INTO CALIFORNIA

| Species | 1952 | | 1953 | |
|---|---|---|---|---|
| | Pounds | Value | Pounds | Value |
| Yellowfin tuna | 185,517,690 | $29,336,957 | 140,544,952 | $22,423,325 |
| Skipjack | 88,891,667 | 11,424,498 | 130,653,919 | 17,999,161 |
| Albacore | 72,328,039 | 12,515,283 | 80,021,442 | 15,853,920 |
| Salmon | 8,127,061 | 2,109,056 | 8,775,383 | 2,192,383 |
| Jack mackerel | 146,521,673 | 4,754,969 | 55,750,855 | 1,993,198 |
| Anchovy | 55,782,870 | 1,153,156 | 84,503,703 | 1,682,966 |
| Bluefin tuna | 4,576,685 | 733,224 | 9,835,302 | 1,560,516 |
| Market crab | 12,997,411 | 1,893,011 | 8,263,717 | 1,424,434 |
| Sole | 20,920,033 | 1,429,984 | 17,527,561 | 1,035,722 |
| Rockfish | 10,722,880 | 610,175 | 12,224,895 | 541,371 |
| Sardine | 14,330,420 | 523,120 | 9,468,953 | 527,811 |
| Yellowtail | 9,446,979 | 874,228 | 5,212,383 | 490,041 |
| Abalone | 4,784,033 | 431,094 | 4,719,504 | 438,723 |
| Spiny lobster | 807,237 | 337,589 | 750,132 | 352,868 |
| Pacific mackerel | 20,604,671 | 785,464 | 7,502,181 | 328,751 |
| Bonito | 2,144,823 | 206,782 | 3,102,647 | 302,697 |
| White seabass | 1,148,706 | 354,549 | 909,074 | 251,554 |
| Barracuda | 2,094,793 | 330,122 | 1,443,706 | 240,696 |
| Squid | 3,670,923 | 170,763 | 8,917,114 | 205,486 |
| Sablefish | 1,889,589 | 167,894 | 2,078,450 | 177,519 |
| Pacific herring | 9,495,386 | 225,662 | 7,975,995 | 172,880 |
| California halibut | 525,530 | 127,107 | 530,461 | 124,302 |
| Grouper | 829,807 | 164,571 | 479,658 | 106,137 |
| Pismo clam | 3,192,254 | 52,992 | 6,317,152 | 105,281 |
| Lingcod | 1,365,601 | 107,226 | 987,430 | 70,562 |
| Black sea bass | 318,050 | 49,073 | 411,979 | 67,883 |
| Swordfish | 313,230 | 118,292 | 142,967 | 67,831 |
| Cabrilla | 574,333 | 86,207 | 413,305 | 67,458 |
| Kingfish | 3,273,524 | 127,815 | 1,201,269 | 61,659 |
| All other | 7,782,442 | 781,995 | 6,663,300 | 617,694 |
| Totals | 694,978,340 | $71,982,858 | 617,329,389 | $71,484,829 |

[1] Value to the fishermen.

TABLE 51

## MARKET CRAB, CALIFORNIA LANDINGS

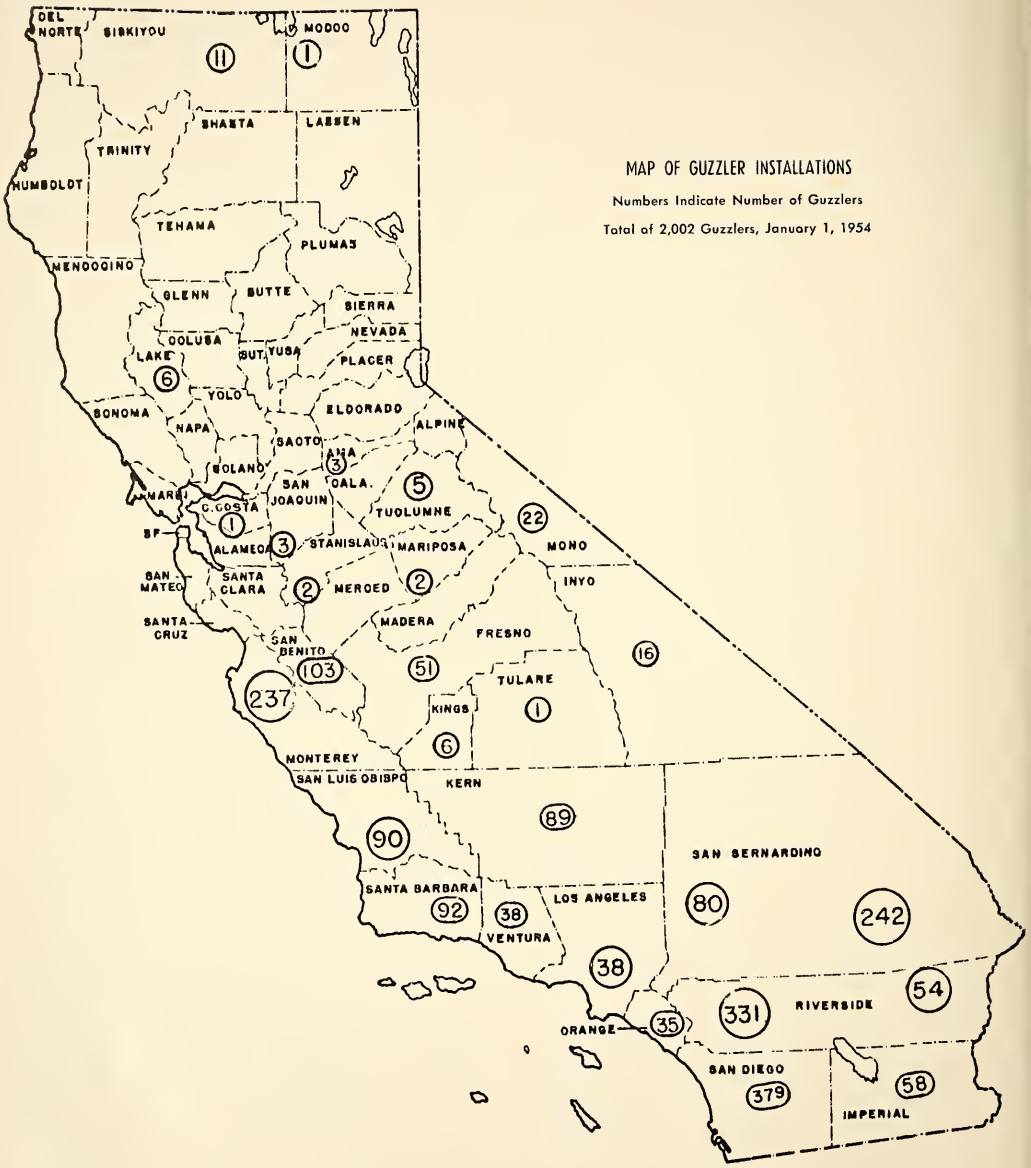
| Year | Market crab pounds | Year | Market crab pounds |
|---|---|---|---|
| 1916 | 1,296,912 | 1935 | 3,680,188 |
| 1917 | 2,580,840 | 1936 | 2,311,802 |
| 1918 | 1,619,280 | 1937 | 1,627,753 |
| 1919 | 1,304,904 | 1938 | 3,873,600 |
| 1920 | 1,220,568 | 1939 | 5,953,361 |
| 1921 | 800,952 | 1940 | 5,151,014 |
| 1922 | 860,328 | 1941 | 4,260,340 |
| 1923 | 1,075,800 | 1942 | 2,414,110 |
| 1924 | 1,506,816 | 1943 | 2,315,338 |
| 1925 | 3,234,312 | 1944 | 2,925,316 |
| 1926 | 3,296,280 | 1945 | 4,333,895 |
| 1927 | 2,960,712 | 1946 | 9,633,630 |
| 1928 | 3,574,464 | 1947 | 10,733,398 |
| 1929 | 1,792,776 | 1948 | 11,912,191 |
| 1930 | 1,992,384 | 1949 | 11,133,046 |
| 1931 | 2,231,384 | 1950 | 11,721,352 |
| 1932 | 2,433,987 | 1951 | 11,568,353 |
| 1933 | 3,208,494 | 1952 | 12,941,418 |
| 1934 | 3,768,081 | 1953 | 8,252,777 |

TABLE 52

## TOTAL ANNUAL LANDINGS AND SHIPMENTS INTO CALIFORNIA OF COMMERCIAL FISH, MOLLUSKS AND CRUSTACEANS

Includes Sardine Deliveries to Reduction Ships During 1930 Through 1938

| Year | Pounds | Year | Pounds |
|---|---|---|---|
| 1916 | 95,002,695 | 1936 | 1,764,900,136 |
| 1917 | 209,876,670 | 1937 | 1,362,983,717 |
| 1918 | 261,134,265 | 1938 | 1,310,595,651 |
| 1919 | 266,270,240 | 1939 | 1,486,534,906 |
| 1920 | 222,004,376 | 1940 | 1,297,517,441 |
| 1921 | 135,347,826 | 1941 | 1,529,147,645 |
| 1922 | 182,343,333 | 1942 | 1,173,414,078 |
| 1923 | 253,874,581 | 1943 | 1,234,049,119 |
| 1924 | 340,445,919 | 1944 | 1,459,445,859 |
| 1925 | 437,502,232 | 1945 | 1,216,467,433 |
| 1926 | 394,964,393 | 1946 | 919,850,476 |
| 1927 | 487,166,143 | 1947 | 795,498,998 |
| 1928 | 583,526,751 | 1948 | 900,499,994 |
| 1929 | 856,854,055 | 1949 | 1,135,338,504 |
| 1930 | 702,188,795 | 1950 | 1,366,677,048 |
| 1931 | 502,389,875 | 1951 | 904,099,052 |
| 1932 | 556,139,053 | 1952 | 694,978,340 |
| 1933 | 821,805,007 | 1953 | 617,329,389 |
| 1934 | 1,390,798,650 | | |
| 1935 | 1,448,016,584 | | |




MAP OF GUZZLER INSTALLATIONS

Numbers Indicate Number of Guzzlers

Total of 2,002 Guzzlers, January 1, 1954

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